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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XXXVII.—1878.

LONDON:
PUBLISHED AT THE OFFICE, BOY COURT, LUDGATE HILL, E.C.
AND SOLD BY ALL BOOKSELLERS.

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THE CHEMICAL NEWS.

VOLUME XXXVII.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 945.—JANUARY 4, 1878.

LIQUEFACTION OF OXYGEN.*

By M. RAOUL PICTET.

The object which I have had in view for more than three years is to demonstrate experimentally that molecular *cohesion* is a general property of bodies, to which there is no exception.

If the permanent gases are not capable of liquefying, we must conclude that their constituent particles do not attract each other, and thus do not conform to this law.

Thus, to cause experimentally the molecules of a gas to approach each other as much as possible, certain indispensable conditions are necessary, which may be expressed thus:—

1. To have the gas absolutely pure, with no trace of foreign gas.
2. To be able to obtain extremely energetic pressures.
3. To obtain intense cold, and to subtract heat at these low temperatures.
4. To utilise a large surface for condensation at these low temperatures.
5. To be able to utilise the rapid expansion of the gas from extreme condensation to the atmosphere pressure—an expansion which, added to the preceding means, will *compel* liquefaction.

Having fulfilled these five conditions, we may formulate the following alternative:—

When a gas is compressed to 500 or 600 atmospheres, and kept at a temperature of −100° or −140°, and it is allowed to expand to the atmospheric pressure, one of two things takes place:—

Either the gas, obeying the force of cohesion, liquefies, and yields its heat of condensation to the portion of gas which expands and loses itself in the gaseous form; or, on the hypothesis that cohesion is not a general law, the gas must pass to the absolute zero and become inert,—that is to say, an impalpable powder.

The work done by expansion will not be possible, and the loss of heat will be absolute.

Struck with the truth of this alternative, which is rendered certain by thermo-dynamic equations based on accurate data, I have sought to produce a mechanical arrangement which should entirely satisfy these different conditions, and I have chosen the complicated apparatus of which the following is a brief description:—

I take two pumps, P_3 and P_4, for exhaustion and compression, such as are used industrially in my ice-making apparatus. I couple these pumps in such a way that the exhaustion of one corresponds to the compression of the other. The exhaustion of the first communicates with a tube (R) of 1·1 metres long and 12·5 centimetres in diameter, and filled with liquid sulphurous acid. Under the influence of a good vacuum the temperature of this liquid rapidly sinks to −65°, and even to −73°, the extreme limit attained.

Through this tube of sulphurous acid passes a second smaller tube (S), of 6 centimetres diameter, and the same length as the envelope. These two tubes are closed by a common base.

In the central tube is retained compressed carbonic acid produced by the reaction of hydrochloric acid on Carrara marble. This gas, being dried, is stored in an oil gasometer (G) of 1 cubic metre capacity.

At a pressure of from 4 to 6 atmospheres the carbonic acid easily liquefies under these circumstances. The resulting liquid is led into a long copper tube (B), 4 metres in length and 4 centimetres in diameter.

Two pumps, P_1 and P_2, coupled together like the first, exhaust carbonic acid either from the gasometer (G) or from the long tube (B) full of liquid carbonic acid.

The ingress to these pumps is governed by a three-way tap, H. A screw valve cuts off at will the ingress of liquid carbonic acid in the long tube; it is situated between the condenser of carbonic acid and this long tube. When this screw valve is closed, and the two pumps draw the vapour from the liquid carbonic acid contained in the tube 4 metres long, the greatest possible lowering of temperature is produced; the carbonic acid solidifies and descends to about −140°. The subtraction of heat is maintained by the working of the pumps, the cylinders of which take out 3 litres per stroke, and the speed is 100 revolutions a minute.

Both the sulphurous acid tube and the carbonic acid tube are covered with a casing of wood and non-conducting stuff to intercept radiation.

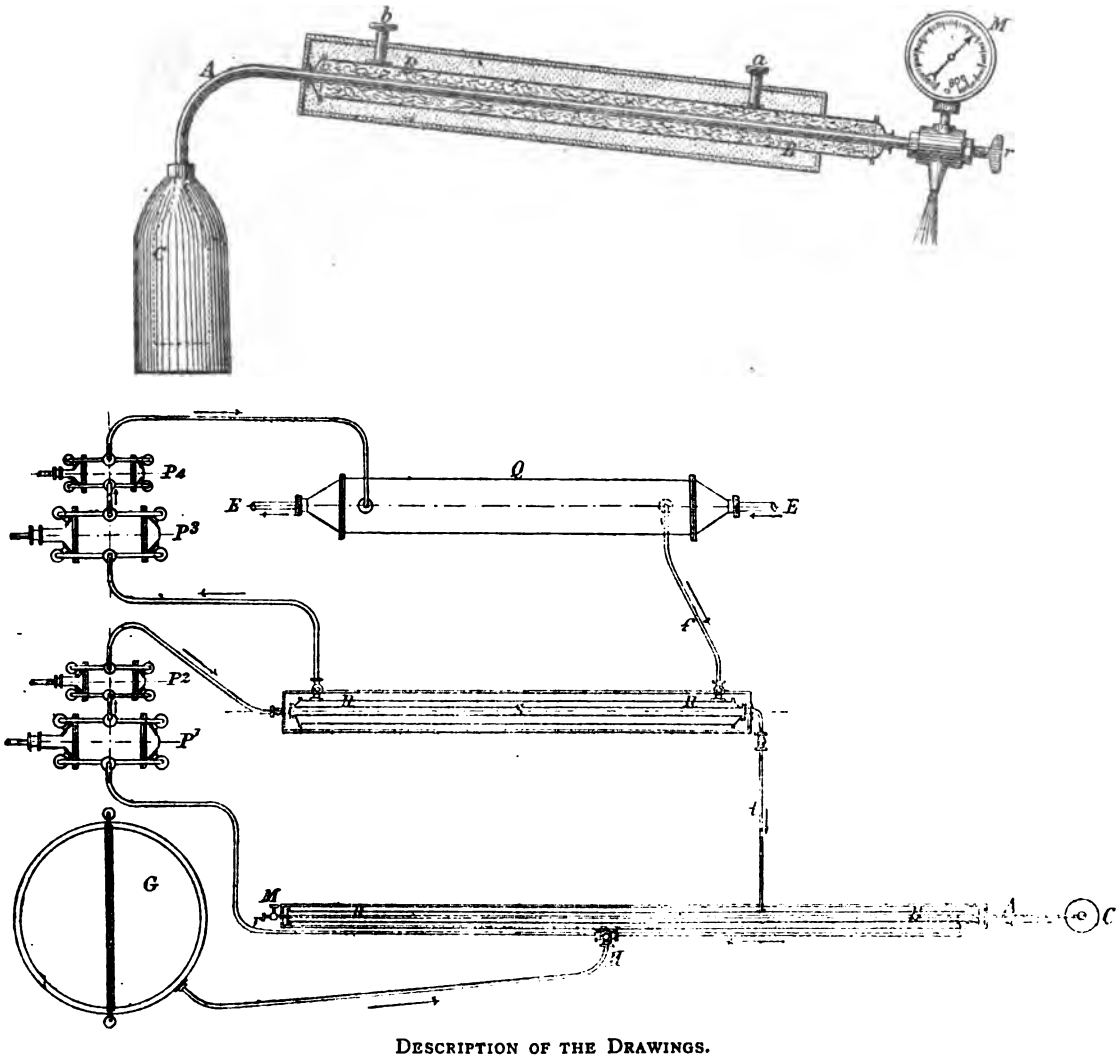
In the interior of the carbonic acid tube, B, passes a fourth tube, A, intended for the compression of oxygen; it is 5 metres long and 14 millimetres in external diameter. Its internal diameter is 4 millimetres. This long tube is consequently immersed in solid carbonic acid, and its whole surface is brought to the lowest obtainable temperature. These two long tubes are connected by the ends of the carbonic acid tube, consequently the small tube extends about 1 metre beyond the other. I have curved this portion downwards and given the two long tubes a slightly inclined position, but still very near the horizontal, as I have shown in the accompanying drawing.

The small central tube is curved at A, and screws into

* The *liquefaction of oxygen* is so important a scientific achievement that we have much pleasure in laying before our readers the following detailed account of the means employed and diagrams of the apparatus used, which have been communicated to us by M. Pictet himself.—Ed. *C. N*

he neck of a large howitzer shell, C, the sides of which are 35 millimetres thick; the height is 28 centimetres, and the diameter 17 centimetres.

This shell contains 700 grms. of chlorate of potash and 256 grms. of chloride of potassium mixed together, fused, then broken up, and introduced into the shell perfectly dry. When the double circulation of the sulphurous and carbonic acids has lowered the temperature to the required degree, I heat the shell over a series of gas-burners. The decomposition of the chlorate of potash takes place at first gradually, then rather suddenly towards the end of the operation. A pressure-gauge, M, at the extremity of



DESCRIPTION OF THE DRAWINGS.

A. A tube, 5 metres long, 14 millimetres external diameter, and 4 millimetres internal diameter, in which the oxygen condenses. It is furnished with a screw-tap, *r*, from which the liquid oxygen jets out. A pressure-gauge, M, measures the pressure up to 800 atmospheres.

B. A tube, 4 metres long, in which is solid carbonic acid. The stock of carbonic acid is contained in a gasometer, G, of 1 cubic metre capacity. A three-way tap, H, puts it when desired into communication with the apparatus.

C. A howitzer shell, containing 700 grms. of chlorate of potash mixed with chloride of potassium. It is heated with gas.

P_1, P_2. Double-action exhaustion and force pumps, drawing carbonic acid from the tube B or the gasometer G, according to the position of the tap H.

S. A tube, 60 millimetres diameter and 1·1 metre long, in which is condensed the liquid carbonic acid compressed by the pumps. This liquefied gas returns by the small tube *t* to the tube B.

R. A tube, 125 millimetres in diameter and 1·1 metres long, containing liquid sulphurous acid.

P_3, P_4. Double-action exhaustion and force pumps, exhausting sulphurous acid gas from the tube R.

Q. A tubular condenser of sulphurous acid compressed by the pumps. This body, when liquefied, returns by the small tube *f* to the tube R. The cold water for condensing the sulphurous acid passes through the apertures E E.

a. Entry for liquid carbonic acid.

b. Exit for the vapourised carbonic acid caused by the suction of the pumps.

the long tube, lets me constantly observe the pressure and the progress of the reaction. This gauge is graduated to 800 atmospheres, and was made for me expressly by Bourdon, of Paris.

When the reaction is terminated the pressure exceeds 500 atmospheres; but it almost immediately sinks a little, and stops at 320 atmospheres. If at this moment I open the screw-tap, *r*, which terminates the tube, a jet of liquid is distinctly seen to spirt out with extreme violence. I close the tap, and in the course of a few moments a second jet —less abundant, however—can be obtained.

Pieces of charcoal, slightly incandescent, put in this jet inflame spontaneously with inconceivable violence. I have not yet succeeded in collecting the liquid, on account of the considerable projectile force with which it escapes, but I am trying to arrange a pipette, previously cooled, which possibly may be able to retain a little of this liquid.

Yesterday I repeated this experiment before the majority of the members of our Physical Society, and we had three successive jets, well characterised. I cannot yet determine the minimum pressure necessary, for it is evident that I have a surplus pressure produced by the excess of gas accumulated in the shell, and which could not condense in the small space represented by the interior tube.

I hope to utilise a similar arrangement in attempting the condensation of hydrogen and nitrogen, and I am especially occupied with the possibility of maintaining low temperatures very easily, thanks to four large industrial pumps which I have at my disposal, worked by a steam-engine.

Geneva, December 25, 1877.

Since receiving the above we have been favoured with further particulars of an experiment which was performed for the fourth time on Thursday, December 27th, in the presence of ten scientific men—among others, Professor Hagenbach, of Bâle, who came expressly to assist at this important experiment.

At 10 o'clock in the evening the manometer, which had risen to 560 atmospheres, sank in a few minutes to 50[illegible] and remained stationary at this figure for more th[illegible] an-hour, showing by this diminution in th[illegible] part of the gas had assumed the liq[illegible] influence of the 140 degrees of cold [illegible] posed. The tap closing the orifice of [illegible] then opened, and a jet of oxygen spirted ou[illegible] dinary violence.

A ray of electric light being thrown on the escaping jet showed that it was chiefly composed of two parts;—one central, and some centimetres long, the whiteness of which showed that the element was liquid, or even solid; the other exterior, the blue tint of which indicated the presence of oxygen compressed and frozen in the gaseous state.

The success of this remarkable and conclusive experiment called forth the applause of all present.

We understand that Messrs. Pictet and Co., of 22, Rue de Grammont, Paris, are fitting up apparatus with the intention of having these experiments repeated at their Freezing-Machine Works, at Clichy, in Paris.

Liquefaction of Hydrogen and Nitrogen.—We read in *The Times* that on the morning of Monday, December 31st, 1877, in the presence of three members of the Institute, M. Cailletet effected the liquefaction of hydrogen, nitrogen, and atmospheric air, thus proving that all gases can be liquefied.

An Experiment on Betulin.—E. Paterno and P. Spica, on distilling betulin with anhydrous phosphoric acid, obtain an oily liquid, boiling between 245° and 250°, and having the composition—Carbon, 89·23; Hydrogen, 10·74.—*Gazzetta Chimica Italiana.*

NOTES ON THE CARBOLIC TEST FOR NITRIC ACID.

By DAVID LINDO.

(1.) THE deep magenta colour produced by this test disappears on the addition of water: the fluid acquires a yellowish tint, and a slight brown precipitate subsides. On evaporating the solution the red colour reappears.

(2.) Alkalies in excess change the magenta colour to green. On adding sulphuric acid again in excess the magenta colour returns.

(3.) The green coloured fluid produced by the action of alkalies in excess on the magenta can be diluted with water without suffering change. The reaction is sensitive, and useful as affording additional proof of the presence of nitric acid, which may be required where in applying the red test too much carbolic acid has been used for the quantity of nitric acid present. In this case the colour, instead of being a bright pure magenta, will incline to brown. With this reddish brown fluid the green colour can be obtained quite distinctly on addition of an alkali in excess if the original colour was caused by the presence of nitric acid. The test may be applied as follows:—

(4.) Place some solution of ammonia (*Liq. Ammon. Fort.*, diluted with 2 parts of water) in a small dish, and let one drop of the magenta-coloured fluid at a time trickle down the side of the vessel into the alkali. Some care is required, as the fluid may spirt. With the fixed alkalies no spirting occurs, but, according to my observation, the colour produced is not so fine as with ammonia. The green colour is developed immediately as the fluids come in contact, and is often very bright. Sometimes, however, it is otherwise, and I have found some magenta fluids give a yellow instead of green colour on addition of alkalies, which appears to be due to nitric acid being in excess of carbolic in the red fluid.

(5.) If some sulphuric acid is placed in a test-tube, and a small quantity of the green fluid allowed to flow a drop or two at a time gently down the side of the tube, the red colour will appear when the green fluid reaches the acid at the surface of contact.

(6.) A solution of nitre was made in the proportion of 1 grain to 160 ounces of distilled water. Half an ounce of this solution, mixed with an equal bulk of sulphuric acid, gave a reaction, though not a very distinct one, on addition of some carbolic solution. The sulphuric acid and water had been previously tested, and found free from nitric acid.

(7.) The magenta colour is developed very imperfectly or not at all if the nitric acid is very much in excess of the carbolic. Want of knowledge of this fact might lead to the inference that nitric acid was absent, or present in only minute quantity in cases where it is really in excess. With excess of carbolic the colour inclines to brown, as stated above. If these facts are borne in mind, and a little care taken in applying the test, the colour can always be obtained of great purity and beauty.

Falmouth, Jamaica, Nov. 22, 1877.

RESEARCHES ON THE PHYSIOLOGICAL FUNCTION OF VINE-LEAVES.

By Dr. H. MACAGNO

FINDING that vine-leaves contain a considerable quantity of starch, dextrin, grape-sugar, and potassium bitartrate, I was led to inquire into the conditions for obtaining these matters in the leaves, and their probable relation with the ripeness of the grape.

The following are the results of a first analysis, made on the 20th of June, 1877:—

	In 1 kilogrm. of Leaves	
	Grape-sugar. Grms.	Potass.-bitart. Grms.
Leaves of the superior part of branches with grapes	14·24	7·41
Leaves of the inferior part, ditto..	10·81	5·12
Leaves of the branches without grapes	11·93	4·91
Leaves ditto ditto ..	11·65	6·90

The following table indicates the successive degrees of this physiological work, as shown by analysis, on the leaves and on the grapes, during the vegetation progress, at different times :—

	In 1 kilogrm. of Leaves taken at the end of branches with fruits.		Grape-sugar in 1 kilogrm. of	
	Grape-sugar. Grms.	Potass.-bitart. Grms.	Grapes. Grms.	Stones. Grms.
June 20	14·24	7·41	—	—
August 4 ..	15·31	12·52	9·41	10·00
„ 16 ..	15·96	11·84	33·67	34·14
„ 31 ..	16·62	12·29	66·19	81·66
September 15	20·50	—	91·15	112·00
Oct. 5 (vintage)	23·70	—	117·41	128·15
October 12 ..	19·04	—	—	—

These facts lead to the conclusion that the grape-sugar and tartaric acid are chiefly formed in the superior leaves of the branches having fruit; and the last table shows that this sugar-production increases as the grapes increase in ripeness, and that it diminishes after vintage. I have also found grape-sugar in the branch itself bearing fruits, the leaves of which have been analysed. A very small quantity of starch and dextrin is found in the branches, while, on the contrary, they abound in the leaves. This is shown in the following results of analyses made with 4 kilogrms. of leaves and 4 kilogrms. of branches :—

	Leaves. Grms.	Branches. Grms.
Grape-sugar per kilogrm, ..	11·28	8·25
Starch and dextrin ditto ..	3·77	0·98

For it, I am induced to behold the leaves as the laboratory for the grape-sugar production, and the young branches as conductors of this very precious grape element. I think that such a function of the vine-leaves explains the bad effects resulting from nipping off the vines during the estival season. This is shown also by Guyot, in his "Etudes des vignobles de France" (vol. iii., p. 295). He observed in the Vosges Department a delay of ten days in the ripening of the grapes, in consequence of the vines having been nipped.

I have obtained the same results by practical experiment in this country. Twenty vines were nipped on the 7th of July, 1877; the others of the same vineyard remained in their natural condition. On the 26th of September the analysis of the grapes gave me the following results :—

	From the Nipped Vines. Grms.	From the Unnipped Vines. Grms.
Must in 1 kilogrm. of grapes..	581	620
Grapes without stones ditto ..	54	46
In the Must.		
Specific gravity	1·069	1·075
Grape-sugar per cent	14·000	17·541
Total acidity ditto	1·400	1·320
Fixed matters ditto	21·750	21·950
Potassium bitartrate ditto ..	1·308	1·306

By nipping we have therefore lost 3½ per cent of grape-sugar in the must, and about 4 per cent of must in the grape. The nipping is useful if the vines do not bear well, or if the climate is rather cold; but where the production is abundant nipping should be attended with great care.

Gattinara (Italy), October 20, 1877.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 20, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the visitors had been announced, the minutes confirmed, and a list of presents to the library read, the following certificates were read for the first time :—G. S. Taylor, G. H. Spring, J. V. Elsden, A. H. Hooker.

The first paper was "*On the Bromo-derivatives of Camphor*," by Dr. ARMSTRONG and Mr. MATTHEWS. In preparing mono-brom-camphor the authors find that it is merely necessary to add the requisite amount of bromine to the camphor heated in a water-bath, care being taken to add only a small quantity of bromine at first; heat is then applied to effect the decomposition of the resulting dibromide; on further addition of bromine the decomposition proceeds in a perfectly regular manner. The product is purified by washing with an alkali and re-crystallisation from alcohol. By the action of agents which convert camphor into cymene, bromo-camphor is apparently completely decomposed. It is readily oxidised by nitric acid, sp. gr. 1·3, furnishing much camphoric acid, and a magnificently crystalline body, at present under investigation. The authors find that if bromine be added to camphor (2 molecules of the former to one of the latter) and the mixture heated for a short time in the water-bath, dibrom-camphor is obtained, melting at 57° to 58°, in colourless glistening prisms; this substance is dissolved, and decomposed by nitric acid, sp. gr. 1·4, furnishing a neutral substance with properties far less characteristic than the product from mono-brom-camphor, but no camphoric acid.

The next communication was "*On the Action of Iodine on Camphor*," by Dr. ARMSTONG and Mr. EASKELL. The authors have investigated the so-called camphin of Claus, which they obtained in quantity as a by-product in preparing carvacrol from camphor by Fleischer and Kekulé's method. After extracting the carvacrol with sodic hydrate a current of steam was passed through the residue; the distillate freed from camphor by extraction with dilute sulphuric acid (1 acid, 2 water) was re-distilled in presence of sodium. In fractionating the product the authors found a slightly modified form of Le Bel and Henninger's fractional distillation apparatus of the greatest use. (It can be obtained from Messrs. Cetti.) Almost all passed over between 115° and 215°; the quantity between 160° was small. The quantity between 160° and 168° was very considerable; on examination it was found to be in all probability the hydrocarbon, $C_{10}H_{20}$, but resembles in some respects the paraffin, $C_{10}H_{22}$. The next considerable fraction boiled at 174° to 176°; it consisted chiefly of cymene. The higher portions which, in the aggregate, constitute a by no means unimportant proportion of the entire product, contained much laurene of Fittig, Köbrich, and Jilke, and one if not two hydrocarbons. The authors are continuing these investigations, and Dr. Armstrong stated that he had made much progress in the examination of the mixtures of hydrocarbons obtained from camphor by the action of the so-called dehydrating agents, for in no case, apparently, is cymene the only product; he proposes also to repeat Weyl's experiments on the action of hydriodic acid on camphor, and to prepare hydrides from cymene.

The third paper was read by Dr. ARMSTRONG "*On the Constitution of Terpenes and of Camphor.*" In the author's opinion the generally received hypothesis that the terpenes are dihydrides of cymene is quite irreconcileable with their properties. They do not yield acids related to the hydrocarbons of the benzene series in any quantity on oxidation, neither do they furnish characteristic nitration products; moreover, they combine with

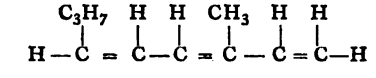
bromine with great facility, they unite with the haloid acids at ordinary temperatures, and combine with water, forming compounds such as terpin, $C_{10}H_{18}(OH)_2$. A dihydride of cymene might be expected on oxidation to lose the "added" hydrogen, to have its side chains affected, but the formation of compounds whose constitution is probably (Mielak and Williams) diaterebic and terebic acids, is quite without analogy. The readiness with which the terpenes undergo isomeric change and are polymerised is also at variance with the above hypothesis. The evidence as to the real constitution of the terpenes is at present extremely unsatisfactory, and insufficient; their conversion into cymene and behaviour on oxidation, the two most important elements for discussion, involving apparently opposite conclusions. The facility with which they form additive compounds tends, however, to support the conclusions derived from their behaviour on oxidation, *i.e.*, that they do not contain a closed chain of six carbon atoms, and if this be the case cymene is doubtless the end product of a series of changes; whether the carbon atoms are all united in an open chain or partially in a closed chain of perhaps fewer than six seems quite uncertain. The evidence as to the constitution of camphor is equally incomplete; it is by no means established that camphor and the terpenes are so closely related as has been supposed. There is little doubt that it does not belong to the alcohols or aldehyds, but probably contains oxygen in the form in which it exists in ethylene oxide or in the ketones. From the fact that *homologous hydrocarbons* are formed with cymene by the action of the so-called dehydrating agents and other considerations, the author concludes that camphor does not contain a cymene nucleus in which the propyl and methyl groups are relatively in the para position. No formula hitherto proposed explains satisfactorily the ready formation of an anhydride from camphoric acid. In conclusion the author states that the evidence as to the constitution of terpenes and of camphor is very conflicting, but that from their entire behaviour these bodies appear to be compounds of an altogether peculiar constitution.

The PRESIDENT remarked that as Dr. Tilden had a paper on a similar subject he would ask him to read it before any discussion took place on the papers which had just been read.

Dr. TILDEN accordingly read his paper "*On the Hydrocarbons Obtained from Pinus Sylvestris, with Remarks on the Constitution of the Terpenes.*

1. *Russian Turpentine Oil.*—Obtained as a by-product during the distillation of wood, chiefly that from *P. sylvestris* and *P. Ledebourii*, for the purpose of preparing tar; sp. gr. 0·8682; 100 m.m. rotated 17° to the right. It had a yellowish colour and pleasant odour. After removing small quantities of acetic acid and creosote it was distilled, four principal ingredients being ultimately obtained. 10 to 15 per cent of a terpene boiling at the same temperature as australene (156°) and identical with it chemically; 100 m.m., however, rotate +23·3°. About 66 per cent of a terpene boiling at 171° having a characteristic odour, rotation +17°, sp. gr. 0·86529 at 15°. The remaining ingredients consisted of about 7·5 per cent of cymene, and a terpene boiling 173° to 175°. No solid hydrochloride could be obtained from this terpene, nor any crystalline nitroso-chloride. In addition to the above ingredients the oil contains small quantities of viscid hydrocarbons having high boiling-points.

2. *Oleum Foliorum Pini Sylvestris.*—Obtained by distilling the leaves of the Scotch fir with water; sp. gr. 0·8756; rotation +5° 30'. By careful fractionation two terpenes, corresponding in boiling-point with those above described, the first boiling at 156° to 159°, rotation +18° 48'; in odour it resembles common turpentine, the second constituting two-thirds of the oil, boils at 171°; rotation −4°; sp. gr. 0·86529; no solid hydrochloride could be prepared. In addition, a little cymene and some pleasant-smelling liquids of higher boiling-point were obtained. The author then proceeded to discuss the constitution of the terpenes, and pointed out that there are probably only 3 isomerides amongst the natural terpenes, differing in odour, action on polarised light, &c., which differences can be accounted for without assuming any but mechanical differences of constitution. Thus we have terpenes from American and Russian turpentine with that from the oil of the leaf of *Pinus sylvestris* all boiling at 156° to 159°, sp. gr. 0·860, and dextro-rotatory. The terpenes from French turpentine, oil of sage, and oil of juniper, have the same boiling-point, but are lævo-rotatory. The above form the first group, and all yield the same nitroso-derivatives; terebene probably belongs to the same group. The members of the second group boil at 174°, sp. gr. 0·85, and yield the same nitroso-substitution compounds; they are obtained from the oils of bergamot, sweet orange-peel, lemon, and caraway, and are all dextro-rotatory. The third class comprises the two terpenes of higher boiling-point, 171° to 173°, described above, as obtained from Russian turpentine (probably Atterberg's Sylvestrenes) and oil of *P. Sylvestris*, sp. gr. 0·865; yield no crystalline mono-hydrochloride or nitroso-chloride. All terpenes yield by the action of bromine *a*-cymene, *i.e.*, methyl-propyl-benzene. By oxidation they furnish carbonic and acetic acids; cymene will not combine with hydrogen to produce a terpene; terebene has been obtained from diamylene by removing 4 atoms of hydrogen. From a consideration of the above facts the author suggests the formula—



for *a* terpene. Similarly, by shifting C_3H_7 and CH_3 one atom of carbon to the right, the formula of *β*-terpene is obtained, whilst by shifting the propyl and methyl groups two atoms in the carbon chain, that of *γ*-terpene. These three formulæ furnish a cymene identical in each case. As regards camphor, the author is disposed to consider it as a benzene or cymene derivative, notwithstanding the fact that he has represented the terpenes as consisting of an open chain of carbon, the reasons for which constitution conclude his paper.

The PRESIDENT thought that it would be convenient to discuss the new facts brought forward by Dr. Tilden before proceeding to any arguments as to the theorettical views propounded by him. He was interested to know if the mechanical differences existing in the structure of the various members of the terpenes involved any difference of odour, or whether the odour was due to oxidised substances.

Dr. WRIGHT had some hesitation in accepting only three modifications of the terpenes. Thus, the oils of orange-peel and lemon were classed together; yet whilst the former yielded 80 to 90 per cent of cymene, the latter furnished only 15 to 20 per cent. Moreover, their boiling-points were 2° to 3° apart, and admitting there were at least four terpenes, it was difficult to see how the proposed formula could form the same cymene by a simple reaction.

Mr. KINGZETT agreed generally with Dr. Tilden, but pointed out that all terpenes by oxidation formed peroxide of hydrogen, and that cymene similarly yielded peroxide of hydrogen. On the whole, he was inclined to believe that terpenes were dihydrides of cymene. He had found on oxidising large quantities of oil of turpentine that the American oil oxidised slowly; the Russian oxidised four times as quickly; whilst the Swedish was still swifter. The French oxidised at about the same rate as the Russian. The purer the oil the less readily did it oxidise. Camphor he regarded as resembling the alcohols in its constitution. The constitution as expressed by structural formulæ only represents the way in which a body splits up when subjected to a certain mode of decomposition, and as the products differ with the mode, the derived formulæ cannot represent true constitution.

Dr. Tilden, in reply to Dr. Wright, thought that the difference in the yield of cymene from the oils of lemon and orange was due rather to a difference in mechanical that in chemical constitution.

Dr. Witt pointed out that one benzo-phenol was converted into its isomer with great evolution of heat, so that here, then, was an instance of two isomers having a different physical constitution.

Dr. Armstrong objected to dividing the terpenes into three classes, because there were the camphenes, which must constitute a fourth class. The formula of diamylene, on which Dr. Tilden founded his formula of terpene, was not by any means established. That Dr. Tilden's formula only accounted for three classes of terpenes he regarded as but a slight objection. There was no doubt that our present formulæ were insufficient.

The President said that such discussions were valuable, not only for adding to our knowledge, but for revealing our ignorance. It would be necessary, as science advances, to revise our theories. Our present formulæ simply represented our present state of knowledge, and we must not expect them to survive, but to change for something more true and more perfect. Another point raised was how far we are to distinguish between the chemical and the mechanical structure of a body. After some remarks as to value and interest of the physical properties of a body, Dr. Gladstone concluded by stating that if cymene was contained in the terpenes he should have expected their dispersion to have been higher.

The next paper was "*On Citric Acid as a Constituent of Imperfectly Ripe Mulberry Juice*," by Dr. Wright and Mr. Patterson. A large quantity of unripe mulberries was expressed, furnishing a turbid light brown liquid, having a very acid taste. This was subjected to analysis, and found to contain 70·16 grms. of total solids per litre. The solid matter consisted of citric acid, 26·83 grms.; malic acid, 7·82 grms.; glucose, 2·74 grms.; ash, 9·4 grms.; mucilage, pectin, &c., 23·37 grms. per litre. The presence of citric acid was confirmed by the preparation and analysis of the lime-salt. In conclusion the authors point out that the juice of imperfectly ripe mulberries, as it contains such a quantity of citric acid, and 3·26 grms. per litre of potash salt (calculated as carbonate), may be valuable as an antiscorbutic and as a substitute for lime-juice.

The next communication was made by Mr. Thomas, "*On Cuprous Chloride, and the Absorption of Carbonic Oxide and Hydrochloric Acid Gas.*" The author, after many trials, found the following method for the preparation of the solution of cuprous chloride to give the best results. A long narrow 4-ounce stoppered bottle is filled three parts full with copper-turnings; 6 grms. of ordinary hydrous cupric chloride and 20 c.c. of strong hydrochloric acid are introduced, and the bottle shaken until the $CuCl_2$ is dissolved. 10 c.c. of water are run in so as to float on the acid liquid; the bottle is then violently shaken. The solution becomes colourless instantly, and after the addition of 30 c.c. of water is ready for use. The author finds that such a solution absorbs carbonic oxide with facility, but that when the free hydrochloric is afterwards suddenly neutralised with potassic hydrate as much as 63 per cent of the carbonic oxide is again liberated, and will remain unabsorbed. If the neutralisation be effected slowly, about 4 per cent only will be set free. To avoid any error from this reaction the author neutralises the hydrochloric acid with ammonia before introducing the cuprous chloride solution. He prepares this solution thus:—Some of the above cuprous chloride solution is poured into a small porcelain crucible, and to it is added, by means of a fine pipette, ammonia (1 of 880 to 1 of water) until the slightest shade of blue remains permanent. This solution is introduced at once into the absorption-tube. By this method neither free ammonia nor free acid is introduced, whilst the reagent absorbs carbonic oxide nearly as well as the original acid solution. The absorption is complete in half an hour. It is stated (Sutton's "Volumetric Analysis," p. 367) that sodic phosphate and sodic sulphate owe their absorbent powers, for hydrochloric acid gas, to their water of crystallisation. The author has found that this is not the case, but that these substances form with HCl acid salts and sodic chloride. Ammonic sulphate in saturated solution is, however, the most convenient reagent, and by adding an equal volume of such a solution to the above cuprous chloride solution the hydrochloric acid is neutralised without the liberation of any carbonic oxide. Or the solutions can be mixed before introducing them into the absorption-tube, as the mixture absorbs carbonic oxide with facility.

After the thanks of the meeting had been given to the authors for their respective communications, the Society adjourned to January 17, when the following papers will be read;—"On the Action of Reducing Agents on Potassium Permanganate," by F. Jones: "On the Alkaloids of the Aconite Family: Part II., Alkaloids of Aconitum ferax," by Dr. Wright and Mr. Luff; "On the Action of Sulphuric Acid on Copper," by Spencer Pickering.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

November 26, 1877.

Professor C. Liebermann, Vice-President, in the Chair.

The following communications were presented:—

A. Sauer and E. Ador, "*Determination of Nitrogen in the Nitro-Glycerin of Dynamite.*"—The authors find that the only reliable method for analysing nitro-glycerin is to determine the N by Dumas's method, the necessary amount for combustion being dropped into a weighed amount of fine cupric oxide, which is mixed and inserted into the combustion-tube. By this process 18·5 per cent of N is found, which coincides with the trinitro compound. Schlösing's process for determining N as NO, by treatment with an excess of HKO, yielded but 12·5 per cent. By treating with soda-lime, but 3 per cent of N was obtained as NH_3. Experiments showed that, in contact with alkalies, nitro-glycerin invariably gave rise to NH_3, as well as HNO_3—a fact which explains the incorrect results often obtained hitherto in the determinations of explosive mixtures.

M. Traube defends his "*Chemical Theory of Fermentation*" against the theory offered by Hoppe-Seyler to explain this operation, in which the hypothesis is advanced that the H liberated by decomposing substances attacks the molecules of O in the air, uniting with one atom and freeing the other, which possesses the properties of ozone and causes the accompanying phenomena of oxidation. The author gathers together a number of facts to prove that these latter phenomena never occur in fermentation processes except in the presence of certain agents which serve for the transfer of O, in a manner exactly analogous to the oxidations caused by platinum black in inorganic chemistry.

F. Beilstein and A. Kurhatow, "*Action of Sulphuretted Nitrogen on Nitro-Compounds.*" It is ascertained that H_2S (or KHS, or K_2S) does not reduce dinitro bodies, a reaction beginning only on the addition of NH_3, and the resultant $(NH_4)_2S$ giving rise then merely to substitution products. Dinitro-chloro-benzene (53°) gave in this way tetra-nitro-phenyl-sulphide $[C_6H_3(NO_2)_2]S$, crystallising in yellow needles, exceedingly insoluble in the usual solvents, and forming a sulphone by treatment with HNO_3. Nitro-para-dichloro-benzene yielded similarly $[C_6H_3Cl(NO_2)]_2S$ with K_2S, and chloro-nitro-phenyl-mercaptan, $C_6H_3(SH)Cl(NO_2)$, with H_2S.

F. Kessel, "*Action of Bromine and Chlorine on Chlor*

ethyliden-acetate." By treatment with bromine at 100° the author obtains dibrom-acetic ether,—

$$CH_3.CO.OCHBr.CH_2Br,$$

an oily colourless liquid, decomposing by distillation, and yielding, on treatment with water, acetic acid, crotonic aldehyd, and HBr. Chloro-ethyliden-acetate yields, with Cl at 120° in the presence of iodine, a similar liquid—trichlor-acetic ether, $CH_3.COO.CHCl.CHCl_2$.

C. LIEBERMANN and H. WICHELHAUS present, in two papers, their theoretical considerations "*On the Formula of Quinhydrone*," the first advocating $C_{12}H_{10}O_4$, the second $C_{18}H_{14}O_6$.

R. NIETZKI decides the question by quantitatively determining the amount of H necessary to reduce quinhydron to hydroquinon, by means of sulphurous acid and an iodine solution. Eight experiments gave results coinciding with the formula—

$$C_{12}H_{10}O_4 - C_{12}H_{10}O_4 + 2H = 2C_6H_6O_2,$$

so that quinhydron must be considered as resulting from the union of 1 mol. quinon and 1 mol. hydroquinon.

H. HUNNIUS, "*Derivatives of Aceto-phenon.*" Aceto-phenon-bromide, $C_6H_5.CO.CH_2Br$, results from the action of Br on acetophenon, and forms crystals 2 inches in length. With HNO_3 it gives nitro-aceto-phenon-bromide,—

$$C_6H_4NO_2.CO.CH_2Br,$$

—fine needles, melting at 96°,—which is reduced to $C_6H_4NH_2.CO.CH_2$, and oxidised to meta-nitro-benzoic acid. The bromide yields the acetyl and benzoyl compounds $C_6H_5.CO.CH_2O_2C_2H_3$, &c., on treatment with the respective K salts and alcohol. The former gives rise to aceto-phenon-alcohol, $C_6H_5.CO.CH_2OH$, on heating with Na_2CO_3. A dibromide, $C_6H_5.CO.CHBr_2$, is obtained by adding 2 mols. Br to the solution of aceto-phenon in CS_2. It is oxidised to benzoic acid, and with HKO gives benzoyl-formic acid.

R. NIETZKI obtains "*Methyl-quinizarin,*" $C_{15}H_{10}O_4$, by the action of H_2SO_4 on hydro-toluquinon, at 130° to 150°. It is of a deep red colour, melts at 160°, is more soluble than quinizarin, and crystallises in long crooked needles. Oxidation yields anthr aquinon-carbonic acid and anthraquinon.

A. NAUMANN, "*Distillation of Aromatic Bodies with Aqueous Vapour.*" Nitrobenzene, ethyl-benzoate, and naphthalene, as well as ethyl-bromide, when distilled with steam, show the same peculiarities as the other liquids lately examined by the author, viz., a constant boiling-point which is below that of either water or the other liquid present, and a constant ratio between the quantities of the two liquids in the distillate. It is further ascertained that the ratio between the quantities of water and the accompanying liquid in the distillate, expressed in the molecular weights, is equal to the ratio between the vapour tensions of the two liquids at the temperature of ebullition of the mixture. This fact naturally opens the way to a new method of determining molecular weights, which the author intends to develop.

F. KÖNIG and L. MUTSCHLER, "*Estimation of Free Oxygen in Well-Water.*" The authors find Schützenberger's method (with sodium hydrosulphite, ammoniacal copper solution, and indigo solution) undesirable on account of the rapid decomposition of the standard solution, the difficulty of establishing its titre, and the unreliable results when large amounts of O are present. Mohr's process (union of the O with FeO and titration with permanganate) is much more exact, certain, and rapid. The amount of O present in well-water is found to vary according to the season, being 6 to 6·5 c.c. per litre in April and May, 3 to 3·5 in July and August, and 8 to 10 in October and November.

A. BAUR and J. SCHULER have succeeded in a "*Synthesis of Pimelic Acid,*" by the simultaneous action of KCy and KHO on amylen-dibromide—

$$C_5H_{10}(CN)_2 + 2KHO + 2H_2O = C_5H_{10}(COOK)_2 + 2NH_2.$$

T. H. DIETL and V. MERZ, "*Derivatives of Oxynaphthoquinon.*" These consist of the bromine compound $C_{10}H_4Br(OH)O_2$ and an analogous nitro-compound, both obtained in the usual way, handsomely coloured, and possessing unusual crystalline properties.

F. KRAFFT obtains, by the "*Distillation of Castor Oil in a Partial Vacuum,*" a new fatty acid, $C_{11}H_{20}O_2$, melting at 24·5°, and boiling at 200° under a pressure of 90 m.m.

W. V. MILLER finds "*Methyl-crotonic Acid*" among the products of the oxidation of valerianic acid with potassium permanganate.

H. BECKURTS and R. OTTO, "*α-Dichloro-propionic Acid.*" By heating with H_2O in closed tubes at 150° this acid is decomposed into pyruvic acid—

$$C_3H_4ClO_2 + H_2O = C_3H_4O_3 + 2HCl.$$

In contact with an excess of Ag_2O the acid yields CO_2 and $C_2H_4O_2$ only, and no carbacetoxylic acid as claimed by Klimenko. α-dichloro-propionic acid is found to solidify at −3°.

"*Dichloro-propionitrile.*" By the action of Cl on propionitrile a solid and a liquid dichloro-propionitrile are obtained. The former can be changed into the latter by heating with alkaline metals or sodium amalgam, or by standing for several months.

L. HENRY, "*Etherification by Means of* HCl." The author considers that a carboxyl group in contact with water or alcohol forms a trihydroxide, as $CH_3.C(OH)_3$ or $CH_3.C(OH)_2OC_2H_5$. The latter in contact with HCl forms $CH_3C(OH)Cl(OC_2H_5)$, but as it is impossible for OH and Cl to be united to the same C atom, it decomposes into HCl and—

$$CH_3.C\begin{cases} O \\ OC_2H_5. \end{cases}$$

P. SCHWEBEL obtains "*Phenyl-hydantoïn,*"—

$$CO\begin{cases} NH.CO \\ N.C_6H_5.CH_2, \end{cases}$$

by heating phenyl-glycocoll and urea together at 160°. It crystallises in long colourless needles, melting at 192°, and is easily soluble. The compound is also formed by bringing together in water, potassium cyanate, ammonium sulphate, and phenyl-glycocoll. All attempts to prepare the corresponding phenyl-hydantoic acid failed.

CORRESPONDENCE.

BUTTER ANALYSIS.

To the Editor of the Chemical News.

SIR,—The disadvantage of Hehner and Angell's process for determining the percentage of insoluble fatty acids in butter and in other fats, as originally devised by them, was the fact that portions of the melted fatty acids were liable to pass through the filter-paper.

The disadvantages of Dr. Muter's process, on the other hand, are:—

1. The great quantity of water, and therefore great length of time, required for washing the fatty acids. This is doubtless due to the deposition, on cooling, of part of the soluble acids previously dissolved by the hot water, on the under side of the cake of insoluble acids.

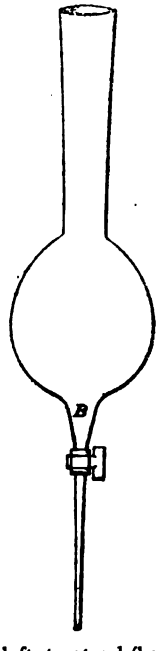
2. Cooling the flask each time the acids are washed takes up time.

3. The difficulty of drying the fatty acids. The melted fatty acids in the platinum dish always have (when Dr. Muter's process is employed) a considerable globule of water under them. This water is prevented from evaporating by the layer of fatty acids over it, and either remains undiminished for hours at 100°, or boils at higher temperatures with violent bumping, and consequent loss of fatty acids. It is impossible to get rid of the water by previous draining of the cake, which during its formation encloses water in cavities of its mass.

What is wanted is a simple plan by which the solution of soluble acids can be separated while hot, and without the use of a filter, and this can be done quite satisfactorily by means of a stop-cock flask, devised by my assistant, Mr. Herbert Robson, B.Sc. Lond., and represented in the accompanying woodcut. It holds about 300 c.c. The method of procedure is as follows:—

About 10 grms. of tared dry butter fat are saponified in a 12—16 oz. German flask in the usual way, and the alcohol is expelled. Up to this point, but no further, Dr. Muter's process is followed. The alcohol-free soap is now transferred, as hot as possible,* into the stop-cock flask. Here the soap is decomposed by a sufficient quantity of moderately dilute hydric sulphate, previously put into the flask, and still retaining a good deal of the heat evolved on diluting the acid.

Note.—If the hydric sulphate is put in after the soap some of the fatty acid sticks in the part of the flask marked B in the figure, and is difficult to dislodge.



The flask is now left to stand (best all night) until the turbid liquid in it has cleared, and the layer of acids on the surface solified to a cake.† The liquid is now run off through the stop-cock, the flask is half filled with scalding water, and the fatty acids are washed by rotating the contents of the flask, as recommended by Dr. Muter, for two or three minutes. The flask is then left to stand. By the time the rotation has ceased all the fatty acid will have risen to the surface, and as much as possible of the wash-water (which is at about 70°) is then run off through the stopcock. The washing with scalding water is then immediately repeated.

When the insoluble acids are completely washed, and the last lot of wash-water has been run out, the fatty acids are allowed to cool, the formation of a cake being expedited by pouring cold water over the outside of the flask. The stop-cock is now opened, and the cake is allowed to drain. The stop-cock is then shut, and the fatty acids are dissolved *in the flask* in the smallest possible quantity of ether. There will then be found under the ethereal solution nearly all the water present. This is run off by itself (as nearly as possible) into a tared platinum dish, and dried at 100°. The ethereal solution is then run into the dish, and the flask is rinsed out with ether, and the rinsings also run into the dish. The ether is then evaporated, and the fatty acids are weighed.

It will be observed that the stop-cock flask is left perfectly clean, and if the successive portions of wash-water are boiled in the saponifying flask, not only is any loss of soap prevented, but the saponifying flask too is left clean.

The stop-cock flasks are made by Messrs. Cetti and Co. The process works quite easily, and by it the determination of the percentage of insoluble fatty acids is made with accuracy and certainty. It has been employed in all the analyses of fats that have been made in my laboratory during the year, amounting to a considerable number.—I am, &c.,

W. H. Corfield, M.A., M.D. (Oxon).
Professor of Hygiene and Public Health, University College.

December 4, 1877.

* It is well to rinse out the flask just before use with scalding water so that it may not chill the soap.

† If the flask cannot be left long enough for the turbid liquid to clear spontaneously it may be run off, boiled, and then put back. This will very greatly accelerate its clearing.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

To the Editor of the Chemical News.

Sir,—The writer is one of the many "provincial" chemists who have been anxiously watching and waiting for the definite organisation and starting of the above association, and who have all felt how desirable and necessary such a union of chemists has become. From time to time information has been given in the Chemical News, and recently it was announced that all was at last ready for the launch, some details being afforded as to the qualifications for election, fees, &c. But this information was not given as coming directly and officially from the heads of the new organisation, and we naturally supposed that in due course the council would publish some definite and formal announcement of the commencement of its functions, the objects proposed to be obtained, the methods by which they are to be obtained, &c., and a full list of all those chemists who have to do with the management of the affairs of the Institute, election of its Fellows, expenditure of its funds, &c. To our surprise, nothing of the sort has appeared: but in the last issue of the Chemical News is a note signed by Mr. Groves, as Secretary, in which he says that the association, "of which you gave some account," is incorporated, and has "begun active operations," over 300 chemists being already elected as Fellows.

Is this little note, and its almost casual allusion to the association of which you "gave some account," to be the only announcement we are to receive, and the only invitation to be issued to the profession, to come forward and give support, derive benefits, &c.? It must not be forgotten that the whole organisation has been arranged by a council of chemists in London, the great body of chemists all over the country knowing little or nothing of their doings or proposals, or even who they were. This could not well be avoided, and was doubtless the best way of getting the subject into some practical shape. But now that the long deliberations are over, is no official account of the results to be laid before the great body of chemists who know *nothing* of what these results are? It may be that some such official statement or prospectus has been issued; but if so I can only say that it has escaped the notice of very many of us. Surely it is not right, and no wise, that the first statement of the commencement o operations should reach many of us through the medium of a note of a few lines from the secretary, simply referring to "some account" given by you, and vouchsafing nothing more excepting the announcement that after February 2 the entrance fee will be raised to five guineas. This gives us some eight weeks, and we gather that the election of Fellows has been going on for some time. Hundreds of chemists probably did not know that any commencement was yet being made! Would it not be

ell to publish in the Chemical News and elsewhere very full information for all of us? How else can we obtain it?

A few of the things of which we desire a proper knowledge are as follows:—

Full list of Council and Officers.

Qualifications for election as Fellow; and what form of application must be made by candidates for that honour?

What does the Council propose to *do* to attain the objects we all so much desire? What use is to be made of the funds of the Institute, and who is to make it?

Is there going to be any publication connected with the Institute?

The names of the leaders of the new organisation, so far as we can get to know them, are a very high guarantee for the value of the privilege of fellowship, and the dignity and usefulness of the Association. But I must repeat that too many of us know nothing, and have no means of knowing anything, as to the methods by which it is proposed to benefit us and raise the standard of our profession, nor as to what we and the profession would gain by our coming forward and supporting the Institute by becoming Fellows and adding to the funds. The writer and many others, as above stated, have fully seen and acquiesced in the necessity for the organisation being formed in London, and formed quickly. But London chemists cannot alone support the Institute, and the far larger body of chemists over the country will mostly require something more definite than a few lines from Mr. Groves before they see that they have cause to come forward and give that support without which the Institute will not stand long, nor effect anything while it stands.

As one of the many, and as one who feels an earnest desire for the success of the movement, whose greatest benefits will be even more for our successors than for ourselves, I respectfully and urgently request that something more definite than a short note, casually alluding to "some account" gone before, may very soon be given to us.—I am, &c.,

Well Wisher.

Manchester, Dec. 26, 1877.

AMMONIA IN FILTERED WATER.

To the Editor of the Chemical News.

Sir,—I wish to draw the attention of analysts to a circumstance of much importance connected with the purity of water. I have lately been engaged in the analysis of a well water, the composition of which is as follows:—

	Grains per Gallon.
Lime salts, &c. (chiefly carbonate ..	9·65
Salt (NaCl)	7·96

No free ammonia, and only the smallest trace of albuminoid ammonia.

My client has been using one of the "Spongy Iron Filters" for the past six weeks, and a sample of such filtered water was also sent to me for analysis, with the following result:—

	Grains per Gallon.
Lime salts, &c.	10·30
Salt (NaCl)	7·20

And *free ammonia* 7·30 *parts per million!*

I was at a loss to understand the cause of this last and apparently serious contamination: it was clearly my duty to investigate the matter, and, if *then* a mystery, to condemn either the water or the filter. But (and I think the profession will agree with me) the cause is plain enough: iron in the presence of air and water becomes oxidised, and hydrogen is liberated, which in the *nascent* state unites with atmospheric nitrogen, and *ammonia* is formed.

I think that although a simple and natural reaction, and one to be anticipated, yet that, in the interests of the Water Company and the profession, some note should be [illegible] of it. I may add that many repetitions were made of the analysis, and every precaution taken to avoid contamination of the water by laboratory fumes.—I am, &c.,

T. Jones.

Chemical Laboratory, 106, Leadenhall Street, December 20, 1877.

ACTION OF SUNLIGHT UPON SOLUTIONS OF OXALIC ACID.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xxxvi., p. 279) is a short note on the "Action of Light upon Solutions of Oxalic Acid," by Dr. Downes and Mr. T. P. Blunt, of Shrewsbury. Their observations lead to the conclusion that oxalic acid of the decinormal strength is entirely destroyed when exposed to sunlight for some time. They leave the nature of the change for a future enquiry. I can quite confirm the observation of these gentlemen, and I may state that it has been known to me for some time, as I have repeatedly made such solutions of oxalic acid for the analysis of air by Pettenkofer's method. Some solutions I have noticed keep better than others. Thus, if my memory serves me, oxalic acid made by oxidising sugar with nitric acid is more permanent in solution than that obtained by carefully re-crystallising commercial samples. In every instance where decomposition has taken place I have found the mycelium of a fungus in the liquid, and hence I have attributed the change to the action of a fungus. In order to preserve the volumetric solution, I prepare it with water containing from 10 to 25 per cent of alcohol. This I find efficacious for a period of at least four months, and, as it obviates the inaccuracies which may otherwise arise, it may be deemed of sufficient interest to warrant an insertion in your valuable journal.—I am, &c.,

W. N. Hartley.

King's College, London, December 29, 1877.

ACTION OF SUNLIGHT UPON SOLUTIONS OF OXALIC ACID.

To the Editor of the Chemical News.

Sir,—The fact that sunlight rapidly acts on solutions of oxalic acid is not quite so new as Dr. Downes and Mr. Blunt (Chem. News, xxxvi., 279) seem to believe. Most chemists who are in the habit of employing that reagent in volumetric analysis are aware that its solution should be kept in the dark. In strong sunlight the decomposition is very rapid. Thorpe, in his paper "On the Amount of Carbonic Acid in the Air of Tropical Brazils (*Journ. Chem. Soc.*, 1867) states that he was under the necessity of discontinuing the use of oxalic acid solution, as recommended by Pettenkofer, on account of the rapidity of the alteration of its titre in the strong light of the tropics.—I am, &c.,

H. P.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 24, December 10, 1877.

Application of Leyden Jars of a Large Surface for Distributing the Effect of the Current from a Single Source of Electricity, and for Strengthening such Effect.—P. Jablochkoff.—The author's object is the production of an electric light at several points with a single source of electricity.

Law of the Absorption of Radiation through Bodies and on its Application in Quantitative Spectral Analysis (Second Part).—G. Govi.—Theoretic considerations, confirmed by experiment, have demonstrated to physicists that a mono-chromatic radiation, *i.e.*, one of a single wave-length, is extinguished by absorption, so that we have $I_1 = Ik^x$, I representing the intensity of the incident radiation; I_1, that of the same radiation after its passage through a thickness, x, of the absorbent medium. The magnitude k, called the coefficient of absorption, and which is always fractional, expresses the intensity of the light which has traversed the unity of the thickness of the medium. This reaction enables us to calculate the value of k for any wave-length soever as soon as we know the ratio of the two intensities $\frac{I_1}{I}$ for a thickness x of the medium traversed. When the coefficients k are once known nothing is easier than to apply them for tracing the curves of equal chromatic absorption, whether for a refraction spectrum or for the normal spectrum. For this it is sufficient to calculate x, giving to $\frac{I_1}{I}$ a constant value for all the different points of the spectrum, and employing for each point the corresponding coefficient of absorption. We may thus obtain as many points as we wish of the curve which corresponds to any intensity whatever, and construct by equidistant sections or by curves what may be called the surface of chromatic absorption in any given medium. Such researches cannot be made with an ordinary spectroscope, but a "photometer-analyser" must be applied, that is to say, an instrument by which the different simple radiations which form part of a complex radiation may be measured photometrically. If the principle of the photometer-analyser is once known, nothing is easier than to imagine for such an instrument very different arrangements which may almost equally well answer the end in view. It is sufficient to imagine a kind of spectroscope, the slit of which is divided into two parts longitudinally, and receives different radiations upon each half. If it is requisite to study absorption we leave one half of the slit free, and place before the other half a stratum of known thickness of the absorbent medium we wish to examine. The light coming from the two halves of the slit is decomposed by a prism into two spectra, which are in juxtaposition for their entire length, and one of which only has been modified by absorption. If we then endeavour to equalise these two spectra successively (by modifications of the slit, by polarising apparatus, or otherwise), at a very large number of points corresponding to determined wave-lengths, we obtain the measure of the intensity of the different radiations absorbed. When these intensities are once obtained we may deduce from them directly the coefficients of absorption corresponding to each radiation, and the form of the surface of chromatic absorption in the body which is under examination. If we have some coefficients of absorption of a substance dissolved in known quantity in a medium either non-absorbent, or having an absorbing power feeble and already measured, it is easy to determine the quantity of this same substance in another solution. It is merely requisite to take a stratum of the solution of known depth, and place it before the slit of the analytic photometer, measuring then the intensity of the radiations transmitted to know at once to what depth of the normal solution the same intensities would correspond, and consequently what is the quantity of the absorbent matter contained in the solution to be determined. Spectral analysis thus becomes a true method of quantitative analysis, and its applications are at once greatly extended. It must not be forgotten that this new method of analysis requires that we should be able to study all the radiations emitted or transmitted by different bodies. If we wish to confine ourselves to the study of the visible radiations, the utility of the method would be greatly reduced. But we substitute for the eye another organ, such as, *e.g.*, a thermo-electric battery, immediately substances which appear to absorb nothing in the luminous spectrum may manifest their presence in the ultra-red portion of the spectrum, and the means to determine their quantity is presented. A solution of aluminic sulphate is a case in point, and by the aid of the galvanometer the proportion of the salt contained in different solutions may be determined. The same will happen with the ultra-violet radiations, the intensity of which may be measured by the eye, by the aid of uranium-glass, or of sulphate of quinine. If it is true, as a large number of observations appear to demonstrate sufficiently, that the luminous spectral lines of incandescent gases, or the dark lines which the same gases may determine by absorption in continuous spectra, are merely isolated and more intense summits of spectral curves of emission or absorption, quite similar to the curves of shade which absorbent solids and liquids produce, and if it is true that these lines may multiply and especially increase in breadth and intensity the condensation and the elevation of temperature of the bodies whence they spring, we comprehend that the determination of the luminous intensity at different points of a spectrum may serve to recognise the temperature and the density of the substance which emits or absorbs them, that is to say, to determine its quantity in a limited portion of space, provided that we have beforehand established the relation which connects the nature of the radiations emitted with the density and the temperature of the body under examination. Thus, then, by assimilating the phenomena of the emission- and absorption-spectra of gaseous bodies to those presented by the absorption-spectra of solids and liquids it does not appear impossible that we may succeed in obtaining quantitative analyses of bodies examined, even when such bodies escape ordinary methods of observation by reason of their tenuity or their remoteness. The "photometer-analyser" may still render other services to science. By applying it in the quantitative and qualitative analysis of the colours proper to different bodies we may hope to place the classification of colours upon an absolutely accurate basis.

Certain Properties of Calcium Chloride.—A. Ditte.—If anhydrous calcium chloride is dissolved in the smallest possible quantity of water the temperature rises as the salt dissolves. If the solution, after it has cooled down to its original temperature, is diluted with successive quantities of water, the temperature rises at each addition, and these increases go on diminishing by degrees, becoming *nil* when a very considerable quantity has been added. The author examines these phenomena from a thermo-chemical point of view.

Application of Palladium Wire for the Determination of Hydrocarbides Mixed with Air in Small Proportions.—M. Coquillion.—To determine small quantities of hydrogen or of carbides of hydrogen mixed with air it has been the custom in laboratories to add to these gases a detonating mixture, thus producing an explosion, which effected the total combination of the oxygen of the air with the hydrogen or with the carbides. The author proposes as a substitute for this method to heat a palladium wire to white redness. The smallest traces of hydrogen or of a hydrogen carbide are thus burnt up without the intervention of a detonating mixture.

Influence of the Soil and of Forests upon Climate.—M. Fautrat.—During the activity of vegetation—in June, July, and August—the trees, in drawing nourishment from the air, produce a movement which is shown in the atmosphere by a slight depression of temperature. Above coniferous trees, however, during the day an elevation of temperature is constantly observed, derived from the solar heat which is retained by the vapours enveloping the tops of the trees. It is to this moist and hot medium that the vigorous growth of conifers upon the poorest soils must be ascribed. In a wood there is always an ascending current of air, and outside there is a lateral current from the wood towards the open country. To the ascending current is due the absence of hail-storms in forests. A be

THE CHEMICAL NEWS.

VOL. XXXVI. No. 946.

LIQUEFACTION OF NITROGEN, HYDROGEN, AND ATMOSPHERIC AIR.

M. CAILLETET has communicated to the *Academie des Sciences* some further particulars on the liquefaction of gases, and at the meeting of the 31st of Decemb.r a paper was read, from which we translate the following:—

"*Nitrogen.*—Pure and dry nitrogen compressed to about 200 atmospheres, at a temperature of +13°, then allowed to expand suddenly, condenses in the most perfect manner; it first produces an appearance like that of a pulverised liquid in small drops of appreciable volume; this liquid then gradually disappears from the sides to the centre of the tube, at last forming a sort of vertical column following the axis of the tube. The duration of these phenomena is about 3 seconds.

"These appearances leave no doubt as to the true character of the phenomena. I first tried the experiment at home at a temperature of —29°, and I repeated it yesterday, the 30th of December, several times at the Laboratory of the Ecole Normale, in the presence of many *savants* and members of the Academy, among whom I am happy to name, with his assent, the venerable M. Boussingault.

"*Hydrogen.*—Hydrogen has always been considered the most incondensable gas, on account of its low density, and the almost complete agreement of its mechanical properties with those of perfect gases. Thus it was only with great doubt as to the result that I decided to submit it to the same tests which had determined the liquefaction of all the other gases.

"In my first attempts I noticed nothing particular, but, as often happens in experimental science, skill in observing phenomena results in causing signs to be recognised under conditions where they had at first escaped notice.

"This is what occurred with hydrogen. On repeating my experiments to-day in the presence of MM. Berthelot, H. Sainte-Claire Deville, and Mascart, who have allowed me to quote their testimony, I have succeeded in observing indications of the liquefaction of hydrogen under conditions of proof which have left no doubt on the minds of the scientific men who witnessed the experiment. It has been repeated a great number of times. Operating with pure hydrogen compressed to about 280 atmospheres, and then suddenly allowed to expand, we saw form an extremely attenuated and subtle mist suspended in the gas and disappearing suddenly. The production of this mist, in spite of its extreme subtlety, seemed incontestable to all the scientific men who witnessed the experiment today, and who took care to have it repeated several times, so as to leave no doubt as to its reality.

"*Air.*—Having liquefied nitrogen and oxygen, the liquefaction of air is thereby demonstrated. It appeared, however, of interest to make this the subject of an actual experiment, and, as might be expected, it succeeded perfectly. I need not say that the air was previously dried and freed from carbonic acid. The accuracy of the views expressed by the founder of modern chemistry, Lavoisier, is thus confirmed as to the possibility of causing air to assume the liquid state, and of producing matter gifted with new and unknown properties—views recalled so appropriately at the last meeting by our illustrious perpetual secretary."

ON THE SULPHATES OF THE VANADIUM TETROXIDE

By Dr. B. W. GERLAND.

1. *Vanadylous Sulphate*, $V_2O_2 2SO_4$.—To the description of this compound, which I gave in the CHEMICAL NEWS (vol. xxxiv., p. 2), I have to add the following:—Prepared by the described method—namely, by rapidly boiling the solution of the tetroxide with a large excess of sulphuric acid—the separated salt, after washing and drying, is obtained in a much more insoluble condition than is stated in the cited paper. When heated with water in a sealed tube 150° for ninety-eight hours, and again for fourteen hours to 170°, only minute quantities enter into solution. But the compound undergoes a change by keeping it at a temperature of about 400° for twelve hours; the colour, which was originally a dirty green, becomes bright green, and in this state it is completely dissolved by a digestion with water in sealed tubes for thirty-six hours at 130°. The solution is perfectly clear, and more or less oily, according to the quantity of water used. It is not decomposed by heating with more water; the slight sediment I had observed before was caused partly by the decomposition of the glass, which was accidentally lead glass, and partly by some impurity in the compound.

The gummy mass left after desiccation of this solution, moistened with water, and left under a glass bell over sulphuric acid, is, in the course of a week or two, converted into crystals, which, according to the following analyses, have the formula $V_2O_2 2SO_4,7H_2O$.

0·2507 grm. yielded 0·1015 grm. V_2O_5, or 40·48 per cent.
0·3723 „ „ 0·1506 „ „ 40·45 „

The average is 40·465 per cent V_2O_5, corresponding t 36·92 V_2O_4.

$V_2O_2,2SO_4.7H_2O$ requires	V_2O_4 ..	36·81
	SO_3 ..	35·35
	H_2O ..	27·84
		100·00

The same analysis was obtained by Crow, by treatment of the acid sulphate with absolute alcohol (*Journ. Chem. Soc.*, 1876, vol. ii., p. 456).

These crystals swell out considerably when exposed to a damp atmosphere, and are gradually converted into a loose mass of small crystals of the composition—

$$V_2O_2 2SO_4,13H_2O.$$

0·2699 grm. of the same gave 0·0879 grm. V_2O_5, corresponding to 29·72 per cent V_2O_4.
The formula $V_2O_2,2SO_4,13H_2O$ requires—

V_2O_4	29·72
SO_3	28·55
H_2O	41·73
	100·00

This salt deliquesces in damp and effloresces in dry air.

The compound $V_2O_2,2SO_4,3H_2O$ is obtained by drying the former salts at 100°. The salt $V_2O_2,2SO_4,7H_2O$ behaved in the following manner:—

0·4986 grm. loss after two hours at 100°, 0·0853, equal to 17·10 per cent.
„ „ loss after five hours more at 100°, 9·1156, equal to 23·18 per cent.
„ „ loss after eight hours more at 100°, 0·1267, equal to 25·41 per cent.
„ „ loss after four hours at 130°, 0·1315, equal to 26·37 per cent.
„ „ leave after calcination 0·1792 grm. V_2O_5, equal to 32·79 V_2O_4.

$V_2O_2,2SO_4,3H_2O,7H_2O$ requires—

		Found.
V_2O_4	32·88	32·79
$2SO_3$	31·58	31·49
$3H_2O$	10·67	10·31
$7H_2O$	24·87	25·41
	100·00	100·00

The compound $V_2O_2,2SO_4,10H_2O$ I have already described (*l. c.*). It was formed in beautiful transparent crystals of 30 m.m. in length, in a larger quantity of the solution which had been standing in the laboratory, loosely covered, for several months. They were too irregular to allow a crystallographical determination.

0·3715 grm. gave 0·1350 grm. V_2O_5, corresponding to 33·15 per cent V_2O_4.

$V_2O_4,2SO_4,10H_2O$ requires—

V_2O_4 .. .. 32·88

Herewith five different compounds of vanadylous sulphate, with water of crystallisation are described, viz.—

$V_2O_2,2SO_4,3H_2O$ (left by drying the following salts at 100°).
$V_2O_2,2SO_4,4H_2O$ (Berzelius).
$V_2O_2,2SO_4,7H_2O$.
$V_2O_2,2SO_4,10H_2O$.
$V_2O_2,2SO_4,13H_2O$.

2. *Acid Vanadylous Sulphate.*—I have described (*l. c.*) a soluble form of the acid vanadylous sulphate obtained from its concentrated solution by precipitation with alcohol, the existence of which has been denied by Crow. This author, following the directions of Berzelius, obtained the neutral vanadylous sulphate by treating the acid salt or its evaporated solution with absolute alcohol. "According to Gerland," he says (*Journ. Chem. Soc.*, 1876, vol. ii., p. 457), "the above method yields a trisulphate, but it appears probable that he did not wash the salt with alcohol sufficiently long to remove all the sulphuric acid." Mr. Crow could not have read my paper, for my method of preparation is essentially different from his, and, bearing in mind Berzelius's reaction of absolute alcohol on the crystals, I stated distinctly that the solution was evaporated "to the consistence of a syrup," and "the separation of solid salt must be avoided;" also that "strong" alcohol was used. I also guarded myself against the reproach of insufficient washing by using the words that the alcohol "still takes up traces of sulphuric acid."

According to Berzelius the decomposition does not take place instantaneously; the crystals of the acid sulphate had to be washed repeatedly with absolute alcohol, and then left in contact with fresh quantities of the same for some time before the swelling of the mass set in. Mr. Crow must have experienced the same behaviour, or else he would not have stated (*l. c.*, 456) "they (viz., the trisulphates) are scarcely soluble in absolute alcohol." The difference of the results is readily explained by taking into account the proportions of real alcohol, acid sulphate, and water.

A solution of vanadium tetroxide, heated with an excess of sulphuric acid to about 120° for several hours, deposits crusts of hard, transparent, blue crystals. These are highly hygroscopic, and are rapidly dissolved by water, alcohol, or ether, under separation of a small quantity of light blue shiny scales. The crystalline crusts were drained on porous tiles, under a bell glass dipping into sulphuric acid, and submitted to analysis. Three different preparations yielded the following results :—

(1.) 0·5324 grm. substance gave $PbSO_4$ 1·0729,
V_2O_5 0·1847
(2.) 0·7565 „ „ „ 1·5443
V_2O_5 0·2532
0·836 „ „ H_2O 0·1335

	(1.)	(2.)
V_2O_4..	31·65 per ct., 1·00 mol.	30·53 per ct., 1·00 mol.
SO_3 ..	53·20 „ 3·50 „	53·89 „ 3·67 „
H_2O ..	15·15 „ 4·43 „	15·95 „ 4·83 „
	100·00	100·37

These figures point to a composition corresponding to the formula $V_2O_2,H_2,3SO_4,3H_2O$.

The scales, which separate from these crystalline crusts on treatment with cold water, were separated from the solution on the vacuum filter, washed successively with dilute and strong alcohol and with ether, and dried over sulphuric acid. They have a beautiful pale blue colour, with strong lustre, and appear under the microscope as square plates, which, according to their behaviour under polarised light, possess no optical axis, and are therefore cubes. (I have to thank my friend Dr. F. Hurter for this and other crystallographical observations.) The compound dissolves very slowly in cold water, but rapidly in hot water, and requires one or two days' exposure to the air to deliquesce. According to the following analysis its composition is represented by the formula—

$V_2O_2,H_2,3SO_4,2H_2O$,

and is consequently distinguished from the crusts by a minus of H_2O:—

The scales dried over sulphuric acid lost, at 130°, 0·8 per cent.

(1.) 0·6870 grm. substance gave $PbSO_4$ 1·3486
V_2O_5 0·2728
1·0728 „ „ H_2O 0·1365
(2.) 0·7730 „ „ loss at 160° 0·0537 = 6·94 pr. cent H_2O
0·6229 „ „ $PbSO_4$ 1·2133
(3.) 0·3278 „ „ V_2O_5 0·1280
0·5066 „ „ $PbSO_4$ 0·9877

	Found. (1.)	(2.)	(3.)	Calculated for $V_2O_2,H_2,3SO_4,2H_2O$
V_2O_4..	36·23	—	35·62	36·18
SO_3 ..	51·83	51·42	51·47	52·10
H_2O ..	12·72	—	—	11·72
	100·78			100·00

The same compound is obtained in larger quantity by heating the solution of vanadate oxide, in a large excess of sulphuric acid, to a higher temperature, 140° to 160°, far a longer time. (It is most probable that the scales are ready formed enclosed in the crystalline crust, and not formed by their treatment with water.) Scales thus prepared and treated as above have, according to the following analysis, the same composition :—

0·9710 grm. substance gave, Insoluble—
$(V_2O_2,H_2,4SO_4,2H_2O)$ 0·0073
$PbSO_4$ 1·8923
0·6424 „ „ V_2O_5 0·2543

Calculated: V_2O_4 .. .. 35·65 per cent.
SO_3 .. .. 57·45 „
Insoluble .. 0·75 „

This acid vanadylous sulphate formed in solutions, which contain potassium, calcium, iron, and probably other metals, encloses such metals, and these cannot be separated by solvents. This peculiarity I have already mentioned of the ammonium vanadate, and it appears to be common to many other vanadium compounds. The small quantity of potassium, calcium, or iron present in the solution facilitates the formation of the scales, increases their quantity, and causes them to be perceptibly less soluble in water. For the preparations of the compound whose analyses are here given the ammonium vanadates were used, prepared by precipitation of potassium vanadate with chloride of ammonium, and containing about 2 per cent H_2O.

(1.) 1·0219 grms. of substance gave—

$PbSO_4$	2·0288	V_2O_5	0·4025
K_2SO_4	0·0184	$CaSO_4$	0·0065

(2.) 0·8046 grm. of substance gave—

$PbSO_4$	1·1757	V_2O_5	0·3060
K_2SO_4	0·0262		

Calculated :—

	(1.)	(2.)
V_2O_4	35·93	34·69
SO_3	52·41	50·17
CaO	0·26	—
K_2O	0·97	1·76

3. *Double Salts of the Vanadylous Sulphate.*—As it was of interest to produce double salts of the vanadylous sulphate in order to characterise the last-described compound as an acid salt, I have extended the experiments described in my former paper (*l. c.*)

The solutions of V_2O_2, H_2, $3SO_4$, $3H_2O$, and K_2SO_4, in the proportion of their molecular weight, were mixed with a large excess of sulphuric acid, and kept for several hours—for No. 1 at 180° to 200°, for No. 2 at 120°. The acid was poured off after cooling, and the small scales purified by washing with cold water, alcohol, and ether, pressing between filter-paper, and drying over sulphuric acid. The salt is like the above-described acid sulphate, only the scales appear rather larger, of paler colour, and are less quickly soluble in water.

(1.) 1·0035 grms. substance yielded—

$PbSO_4$	1·7917	V_2O_5 0·3596	K_2SO_4 0·0870

(2.) 0·6448 grm. substance yielded—

$PbSO_4$	1·1117	V_2O_5 0·2318	K_2SO_4 0·1203

Calculated :—

	(1.)	(2.)
V_2O_4 ..	32·69 p. ct., 1·00 mol.	32·79 p. ct., 1·00 mol.
SO_3 ..	47·13 ,, 3·00 ,,	45·51 ,, 2·89 ,,
K_2O ..	4·69 ,, 0·25 ,,	10·08 ,, 0·54 ,,
Diff. (H_2O)	15·49 ,, 4·11 ,,	11·62 ,, 3·28 ,,
	100·00	100·00

The salts V_2O_2, H_2, $3SO_4$, $3H_2O$, and K_2SO_4 were dissolved in water, in proportion of their molecular weights: this solution dries in air to a pale blue amorphous mass, which was pressed and washed with dilute alcohol. The solution of this salt dries to a pale blue, transparent, gummy mass, without any trace of crystals: this was ground, washed with small quantities of cold water, and dried over sulphuric acid. The same preparation was, with slight alterations, repeated. The analyses of two gave the following results :—

(1.) 0·6290 grm. substance gave—

$BaSO_4$	0·8397	V_2O_5 0·1629	K_2SO_4 0·2695

(This analysis appeared, *l. c.*, page 2, with a mistake.)

(2.) The hot concentrated solutions of the salts, mixed, separated on cooling small crystals: these were collected, pressed, washed with a little cold water and dilute alcohol, and again dissolved in water; after evaporation in the cold a blue gummy substance was left, similar to No. 1.

0·5016 grm. substance gave—

$PbSO_4$	0·7951	V_2O_5 0·1151	K_2SO_4 0·2162

(3.) 1 mol. $V_2O_2,H_2,3SO_4,3H_2O$ and 2 mols. KCl, dissolved in hot water, were precipitated with alcohol. The precipitate was pressed and washed; its solution in water dried to a blue soft mass, of the consistency of honey, which was found to be free from chlorine.

1·0906 grm. substance gave—

$PbSO_4$	1·5708	V_2O_5 0·2415	K_2SO_4 0·2366

(4.) A concentrated solution of 1 mol. $V_2O_2,2SO_4$ was mixed with a hot concentrated solution of 1 mol. K_2SO_4, and precipitated with alcohol. The precipitate was, after washing with dilute alcohol, pressing, and drying over sulphuric acid, submitted to analysis.

1·0212 grms. substance gave—

$BaSO_4$	1·1940	V_2O_5 0·2574	K_2SO_4 0·3135

Calculated for—

	(1.)	(2.)
V_2O_4 ..	23·59 p. ct., 1·00 mol.	20·93 pr ct., 1·00 mol.
SO_3 ..	45·83 ,, 4·04 ,,	41·85 ,, 4·16 ,,
K_2O ..	23·18 ,, 2·09 ,,	23·40 ,, 1·97 ,,
Diff. (H_2O)	7·40 ,, 2·86 ,,	13·82 ,, 6·11 ,,
	100·00	100·00

	(3.)	(4.)
V_2O_4 ..	20·20 p. ct., 1·00 mol.	23·00 p. ct., 1·00 mol.
SO_3 ..	38·03 ,, 3·91 ,,	40·14 ,, 3·64 ,,
K_2O ..	11·73 ,, 1·02 ,,	16·60 ,, 1·28 ,,
Diff. (H_2O)	30·04 ,, —	20·26 ,, 8·15 ,,
	100·00	100·00

These figures show that in no case was a pure substance obtained; still they prove unmistakably that the potassium enters into combination as substitute for hydrogen: however, it appears that a neutral salt is only reached when K_2SO_4 have entered, besides the K_2 replacing hydrogen.

I have not succeeded in obtaining the corresponding compounds with magnesium or sodium. The solutions of the acid, or neutral vanadylous sulphate, mixed with sodium or magnesium sulphate, deposit these latter salts on evaporation in their ordinary crystals.

Dialysis decomposes the vanadylous potassium sulphate rapidly; the vanadylous sulphate penetrates the membrane more rapidly than potassium sulphate. Equal molecules of V_2O_2, $2SO_4$, and K_2SO_4 were dissolved in water, and brought upon the parchment paper. The level in the dialyser rose rapidly 14 m.m., and the outer water had become strongly tinged. The analysis of the latter gave the following results :—

$PbSO_4$	1·6591	V_2O_5 0·4200	K_2SO_4 0·1232

Calculated :—

V_2O_4	0·3832 grm., 1·00 mol.
SO_3	0·4378 ,, 2·38 ,,
K_2O	0·0666 ,, 0·31 ,,

4. *Dialysis of the Acid Vanadylous Sulphate.*—The following analyses show that the salt dialysis causes decomposition of the compound $V_2O_2,H_2,3SO_4$ into H_2SO_4 and $V_2O_2,2SO_4$, the former traversing the membrane more rapidly than the latter.

(1.) 1 grm. $V_2O_2,H_2,3SO_4,3K_2O$ dissolved in 7 c.c. water filled into the dialyser which floated on 15 c.c. water.

Solution from the dialyser gave—

$BaSO_4$	0·3984 grm.	= SO_3 0·1367 grm.,	2·64 mol.
V_2O_5	0·1180 ,,	= V_2O_4 0·1078 ,,	1·00 ,,

Exterior water gave—

$BaSO_4$	0·5412 grm.	= SO_3 0·1858 grm.,	3·28 mol.
V_2O_5	0·1293 ,,	= V_2O_4 0·1179 ,,	1·00 ,,

(2.) 2 grms. $V_2O_2,H_2,3SO_4,3H_2O$ dissolved in 10 c.c water were dialysed into 20 c.c. water.

The first water gave V_2O_4 = 9 c.c. permanganate solution (1 c.c. permanganate = 0·003301 grm. oxygen), equal V_2O_4 0·3094 grm., 1 mol.

$BaSO_4$ 1·4234 grms. = SO_3 0·4888 grm., 3·29 mols.

The second water gave V_2O_4 = 6 c.c. permanganate.

V_2O_5	0·1439 grm.	= V_2O_4 0·1312 grm.,	1·00 mol.
$BaSO_4$	0·6161 ,,	= SO_3 0·2115 ,,	3·35 ,,

The solution which remained in the dialyser gave—

V_2O_4 = 6 c.c. permanganate solution.

V_2O_4 0·2062 grm., 1·00 mol.

$BaSO_4$	0·7542 grm.	= SO_4 0·2589 ,,	2·61 ,,

Macclesfield, November, 1877.

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.

By H. CARRINGTON BOLTON.

(Continued from p. 250).

IV. SUNDRIES.

Mineral.	Formula.	Description.	Locality.
Apatite	$\dot{\dot{C}}a^{3}\dot{\dot{P}}+\frac{1}{2}Ca(ClFl)$	crystals	Mitchell Co., N.C.
Vivianite	$\dot{Fe}^{3}\dot{\dot{P}}+8\dot{H}$	radiated, fibrous	Mullica Hill, N. J.
Pyromorphite	$3\dot{Pb}^{3}\dot{\dot{P}}+PbCl$	crystalline	Bohemia.
Fluorite	CaFl	translucent, massive ..	Muscalonge Lake, N. Y.
Cryolite	$3NaFl+Al_2Fl_3$	massive	Greenland.
Anglesite	$\dot{Pb}\dot{\dot{S}}$	.....	Phœnixville, Pa.
Gypsum	$\dot{Ca}\dot{\dot{S}}+2\dot{H}$	crystals	Montmartre, France.
Samarskite.....	$(\dot{R}^{3}\dot{R}\frac{2}{3})_5\dot{\dot{C}}b_3$	massive	Yancey Co., N. C.
Silver	Ag	pure silver	?
Copper	Cu	copper foil	?
Iron.....	Fe	iron wire.....	?
Zinc	Zn	granulated	Bethlehem, Pa.
Lead	Pb	test-lead	?
Tin	Sn	granulated	?
Aluminium.....	Al	foil	France.
Antimony	Sb	massive, crystalline	?
Bismuth	Bi	massive, crystalline	?

(To be continued).

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 27, 1877.

Dr. R. Angus Smith, F.R.S., Vice-President, in the Chair.

"*On the Construction of a Room or Series of Rooms free from Germ Life, proposed for use in the performance of Surgical Operations*," illustrated by a Model Room and Apparatus, by William Thomson, F.R.S.E.

My object in bringing this paper before the Society is to show what I consider to be a valuable application of a well-known principle, viz., that of filtering from the ordinary air the innumerable spores which are constantly found floating about in it, and so to arrange a room or series of rooms, in which the air may be rendered optically pure. The practicability of producing, and afterwards retaining in a room or rooms of ordinary dimensions, an optically pure atmosphere, were suggested to me by the results of a large number of experiments which I have carried on during the last seven or eight years, but more especially the results obtained from a series of experiments which I commenced about the beginning of this year, on the cultivation of different fungi, the spores of most of which are found in large numbers, floating about in our atmosphere.

Flour paste suggested itself as the best soil I could obtain on which to grow the different fungi. When flour paste is exposed to the air for a few days, as is well known, fungus makes its appearance, and soon completely covers its surface, and if a number of flour pastes be made and exposed in different places, it will be found that different kinds of fungus spring up, in each showing a splendid variety of different colours, and shades of the same colour. It was with a view to isolate and study these different fungi that one of my last series of experiments was commenced, and it became necessary to look for a means of sowing the seeds of each fungus on a soil which should originally be free from spore life, and afterwards should be effectually protected from the falling of other spores from the air on to the soil, and further, should, if possible, give a free and open supply of air to the microscopic plants.

After a few experiments I found that this could be done effectually by placing flour paste in an ordinary glass shade turned upside down, covering the mouth of the shade with a thin layer of cotton-wool placed between two pieces of cloth, the three layers being fixed round the edges of the glass by an elastic band. The paste, when boiled in the vessel thus closed, was afterwards found to remain free from fungus life for any length of time. Having thus been successful by such a rough arrangement in preventing the entrance of fungus spores, I next arranged to try the same experiment on a rougher and larger scale, and consequently had the rough model made which I show here this evening. Each side of this box or room is

made of thin layers of cotton-wool sewn between two two pieces of cloth, with a glass in front, which serves equally as door and window. A conical-shaped piece made of stout paper is pasted to a square frame at its base, which fits against one end of the room. An ordinary glass funnel is placed in this cone, with its stem passing through the apex, which is firmly tied round it, and an india-rubber tube communicating with a pair of bellows is put on the end of the stem; the large end of the funnel is covered with a thin layer of cotton-wool placed between two pieces of cloth, and the whole fixed round the funnel edge by means of an elastic band. When the window at the other end of the room is opened and the bellows worked, a current of air passes through a layer of cotton-wool placed between two pieces of cloth on the mouth of the funnel and then through that at the end of the room, moves bodily along the room and escapes at the window, little or no special currents or draughts being apparently produced. This I obsefved by previously filling the room with fumes. The force of the air, by passing through the two layers of cotton-wool, was evidently equally distributed throughout the whole area of the room. My first experiment with this arrangement was made by simply working the bellows for about twenty minutes to endeavour to drive the impure air, with its floating particles and spores, out of the room by passing into it the filtered air from the bellows; then boiling one-half of some flour paste in a basin inside the room for a minute or two, and lastly, closing the window with the glass, the other half of the paste being boiled in a similar basin and left outside exposed to the ordinary or contaminated air. After a few days the difference between the two pastes was very marked, the surface of the one left outside the room was completely covered with fungus, whereas, only four or five little specks of fungus were observed to be growing on the surface of the one inside the house, which soon developed into 4 or 5 little buttons of fungus. I considered that the spores which had fallen on this flour paste must have been sticking to the sides or roof of the room, and to eliminate this assumed cause of error, I drew out the supporting rods of the room and crushed it up and boiled it in water for half an hour, then allowed it to dry and repeated the same experiments with the two basins of flour paste, the bellows being first worked and the glass then taken out and laid down in the ordinary or contaminated air, then wiped with a clean cloth and put in. In a few days afterwards, the paste outside the house was completely covered with fungus, whilst the one outside was absolutely free from it, and it remained free for nearly a month, when one little speck was observed on it which soon developed into a little button of fungus. This showed that for three weeks after the paste was placed in the room no spore had fallen on it, The only cause of failure I could see was the glass, upon which some spores must have adhered, consequently I had a bag made and sewn on above the window, into which the glass could be pulled in opening the window. When this was done the house was again crushed up and boiled in water, again placed in position, the paste boiled, the window closed, and in this third trial the experiment was perfect. No fungus was developed on the paste inside the house, and after some months it dried up to a hard mass. Thus these thin sheets of cotton-wool forming a room of 10,032 cubic inches capacity, *i.e.*, capable of holding 36 gallons of air, was sufficient to prevent the entrance of spores into it, and thus to preserve the flour paste from decomposition during several months, till it had completely dried up.

These results, I think, conclusively show that ordinary large rooms may be constructed and ventilated with filtered air, by means of fans, so that flour paste, taken as a test standard, would remain in them free from fungus life, and I believe that such a room or series of rooms might be of great advantage in surgery, perhaps as a means of preventing spores from entering the wounds of patients, and so doing away with or lessening the onus put upon the antiseptic treatment, or in giving a better chance of success in serious surgical operations. It is, I understand, believed by many medical men that pus and blood poisoning may be generated in a wound, from the blood corpuscles or bioplasts in the body, and that such developments have nothing to do with the germs of the outside air, and that the antiseptic treatment is employed to assist their development, but no one, so far as I know, has ever proved this beyond doubt, and such an arrangement of a room or rooms as I shall suggest further on would, I believe, be one mode of experimenting, whereby the whole or a great part of a serious obstacle to such researches may be eliminated; but in passing, I should like to mention one slight incident in reference to the development of pus in wounds which would tend to show that certain germs floating in the air are capable either directly or indirectly of developing pus. Some years ago, when working with a solution of albumen, which had been exposed to the air for some time, and which was then putrid, and swarming with bacteriæ, I accidently cut my finger, and some of the putrid liquid entered the wound. I washed it out as well as possible, and thought nothing of it. Next morning it was slightly swollen, and had gathered. I opened it with a knife, and microscopically examined the matter, expecting to find bacteriæ, but to my surprise no bacteriæ could be observed, and all that could be seen was simply pus cells.

The arrangements which I should suggest on the large scale are, a long room or series of rooms in a line, at one end of which should be fitted a fan behind a good filter of cotton-wool, a long pipe with a series of Bunsen burners set along it, so that when all were lit a line or sheet of flame would be produced which might be gently passed along and made to play on every part of the floor, walls, and roof of the room, beginning near the end at which the fan works and going gradually towards the door; by this means any spores adhering to the walls would be destroyed, and no air could pass back to pollute the walls or floor which had been thus purified. A stove might be arranged at the door end of the room, by which cotton garments to cover the ordinary clothes of the surgeons and attendants might be heated to a temperature presumably sufficient to destroy or paralyse the vitality of any spores which might have been adhering to them, and where the knives and other appliances used might be previously heated, and where water used in washing the wounds might be previously heated under pressure. With such an arrangement at an hospital it seems to me that one interesting mode of investigation into some most important subjects might be commenced.

PHILOSOPHICAL SOCIETY OF GLASGOW.

CHEMICAL SECTION.

December 10, 1877.

Professor JOHN FERGUSON, M.A., President, in the Chair.

AT the annual business meeting of the Section, which was held this evening, the Treasurer's and Auditors' reports were submitted and approved of. From the former it was shown that there were 45 associates of the section, in addition to the ordinary members of the Philosophical Society. The vacancies in the Council were filled up by the election of Messrs. James Mactear, Alexander Whitelaw, Edw. C. C. Stanford, F.C.S., and Robert R. Tatlock, F.R.S.E. At the Council meeting, subsequently held, Messrs. Tatlock and Stanford were elected vice-Presidents of the Section; Mr. J. J. Coleman, F.C.S., was re-elected Treasurer; and Mr. John Mayer, F.C.S., was re-elected Secretary.

Two new associates were elected into the Section—namely, Mr. John S. MacArthur, Tharsis Company's Laboratory, Glasgow; and Mr. Alexander S. Maclean, Baker Street, Greenock.

Mr. James Mactear, of St. Rollox Chemical Works, then read a paper on "*An Improved System of Alkali Manufacture.*" He said that what was usually called the "Alkali Manufacture" was in reality a group of chemical processes, constituting by far the most important of all the great chemical industries of the day. Although in outline the process was well described in most text-books, it would not be out of place to give a short sketch of the general scope of the manufacture, leaving out of consideration altogether the so-called ammonia process, which, although at work in two establishments in England, could never be more than a mere fraction of the whole manufacture, unless under most extraordinary conditions as regards ammonia and common salt.

The group of processes together forming the alkali manufacture must be thus stated:—

1. Production of sulphuric acid.
2. Decomposition of common salt by the sulphuric acid, with the production of sulphate of soda and hydrochloric acid.
3. The utilisation of the hydrochloric acid, either for the manufacture of bleaching powder, chlorate of potash, bicarbonate of soda, or sulphur (recovered from the waste produced in the final process of the alkali manufacture).
4. The conversion of the sulphate of soda, by its decomposition with carbon and carbonate of lime, into carbonate of soda and sulphide of calcium, and the subsequent separation of these two compounds by lixiviation with water.

We were indebted, he said, to the genius and skill of Leblanc and his associate Dizé for that combination of processes; and, except in the improved construction of the apparatus, until very recently, the process remained identical with that used by Leblanc and his followers during a period of over three-quarters of a century, notwithstanding the constant researches of chemists and manufacturers. He did not intend to enlarge upon the improvements in the stages of the manufacturing of sulphate of soda and condensation of hydrochloric acid, as well as those of sulphuric acid and bleaching-powder, but proposed to confine himself to the production of alkali from sulphate of soda.

The character of the decomposition which took place had been studied by many of the most celebrated chemists, amongst whom Liebig gave a considerable amount of attention to the subject and invented a process for the production of alkali, which was not generally known; it was based on the decomposition of woody fibre, in the form of sawdust, by sulphide of sodium, and he thought so highly of it that he took steps to protect it both in this country and in France by a patent. However, whilst very beautiful as a theoretical process, it failed completely on a manufacturing scale.

The theory that an excess of lime was absolutely necessary to the formation of an insoluble compound of calcium and sulphur was a favourite one for many years, and appeared in many forms, the variations in the formulæ depending, as might easily be seen, on the proportions of carbonate of lime used in the decomposition. This theory was dissipated by Gossage and others, but yet it was always found necessary to use an excess of limestone over that which their explanation showed to be necessary, and in practice there was commonly used a mixture of—

Sulphate (commercial)	100
Limestone	108
Coal	50 to 60

The only change of any magnitude that had been introduced up to the year 1873 was the system proposed by Messrs. Stephenson and Williamson, of the Jarrow Chemical Works, who, having adopted the improved form of furnace (subsequently to be described), patented the method of heating the limestone and a portion of the coal for some time, so as to produce a small proportion of caustic lime, after which the sulphate of soda and the remainder of the coal was added, and the decomposition then finished as usual. The introduction of the furnace originally invented by Messrs. Elliott and Russell, which was a cylinder of iron lined with brick, and made to revolve on bearing wheels, was a great advance, but the furnaces being of small size and defective construction at first, did not succeed as was expected. From time to time this class of furnace had been improved, however; and from the small one originally erected, which worked some 10 tons per day, there were now furnaces of a modified form, which the author designed in 1873, working 50 tons per day with ease. That great increase of power had not, however, been attained altogether by the altered construction of the furnace, but to the extent of at least one-third by the adoption of the improved system of manufacture which he had introduced, and which he proceeded to describe.

Having studied carefully the various theories of the decomposition taking place in the production of alkali, he became clearly of opinion that the use of more than an equivalent of carbonate of lime was perfectly unnecessary, in so far as the decomposition of the sulphate was concerned. All attempts to produce alkali to advantage on that basis were quite unsuccessful, owing to the great insolubility of the black-ash thus produced.

He satisfied himself, however, that the decomposition was quite perfect, and he had thus reduced the problem to that of the lixiviation. It occurred to him that, if by any simple means the black-ash could be broken up while exposed to the water used in the lixiviation, the difficulty of the insolubility of the black-ash would be got over; and having established the fact that the insolubility of the black-ash seemed to depend very much on the amount of caustic soda existing in the liquors, and that again on the excess of limestone used, he came to the conclusion that if caustic lime in pieces were distributed through the mass of black-ash, that, in slaking, would rend the balls in pieces, and allow the lixiviation to proceed satisfactorily. Having tried this on the large scale, he found it to succeed perfectly, and the improved process as now worked was based on that principle.

It is conducted thus:—The sulphate of soda, with a quantity of carbonate of lime equal to as nearly as possible one equivalent, and a proportion of coal which varies a little with the quality in various districts, is placed in the furnace, which is made to revolve rather slowly at first; the usual melting and decomposition of the sulphate takes place, and when all the sulphate has been decomposed, which is known by various signs, the furnace is stopped and a quantity of caustic lime, in small pieces, is dropped in; the furnace is then set agoing again, and the lime rapidly mixed through the charge, which is then withdrawn as rapidly as possible. It is sometimes necessary to add with the lime some coal, or even cinders, in order to keep the ball as porous as possible. This depends very much on the quality of the coal, which ought to be of such a nature as to leave a considerable quantity of carbonaceous matter in the waste; this, in the ordinary system of working, usually amounts to about 10 per cent on the waste, which equals about 20 per cent on the coal used in the mixture.

The advantages of this very simply conducted process are very great.

First.—By its use the output of the furnaces has been increased from 50 to 70 per cent.

Secondly.—There is a large saving in limestone and coal.

Thirdly.—There is a much reduced quantity of waste.

Fourthly.—There is a considerably increased yield of alkali from a given quantity of sulphate of soda.

(1.) As regards the increased output from a given furnace, this not only gives greater productive power to the plant, but results in a considerable saving of wages; for as the weight of total material per ton of sulphate of soda used is reduced by some 20

per cent, it naturally follows that the weight handled is less, and so also are the costs of labour.

(2.) The limestone in excess in the ordinary process of Leblanc as usually worked gives considerable infusibility to the mass, and necessitates greater consumption of coal for its fusion; whereas, in the author's system, the quantity is reduced as low as possible, and the fusibility of the mixture being much increased there results a considerable saving in fuel.

(3.) The reduction in the quantity of waste (about 30 per cent.) is of advantage in various ways.

(*a*.) The quantity being less, and the percentage of alkali left after lixiviation being no more than on the old system, there is of course a gain of alkali, estimated at about 1½ per cent.

(*b*.) The cost of removal of the waste and its deposit is the source of a considerable expense to manufacturers, and is of course exactly in proportion to the weight produced; so that, if there is 30 per cent. less waste produced, there ought to be 30 per cent. of the cost of removal saved.

(*c*.) As it is almost certain that the production of sulphur from alkali waste will before long form one of the regular processes of an alkali works, owing to the necessity of condensing and utilising all the muriatic acid, for which there is at present only, it may be said, an outlet in the manufacture of bleaching-powder, it is clearly of great advantage to have the waste in a form in which there is as little as possible of useless material, such as carbonate of lime, and which may therefore be the more easily dealt with in the way of oxidation, &c.

4. The reduced quantity of waste also gives, as above, an increase in yield of alkali; but there is also the fact that better decomposition of the sulphate of soda is obtained, as might be expected, from the greater fusibility, and therefore liquidity, of the molten mass, which renders the agitation and mixture more complete.

This process has now been in use for some years at the works of the author's firm (Messrs. Charles Tennant & Co.), and has also been adopted with marked benefit by various large manufacturers both in this country and in France. The amount of saving stated in money varies with the costs of raw material and labour, but may be said to range from five shillings to ten shillings per ton of soda-ash, calculated as containing 48 per cent. of alkali.

In the course of a discussion which followed the reading of the paper,

Mr. TATLOCK referred to the ammonia process, and asked why it had not, or might not, become a commercial success.

Mr. MACTEAR, in reply, said that there were three points which required to be considered in connection with the process, one or more of which must be fulfilled in order that it might be rendered successful. First, there must be cheap ammonia; secondly, there must be cheap salt; thirdly, there must be cheap limestone. Now, the only two alkali works in which it had been adopted in this country were in or near the salt district of Cheshire; and the Belgian works in which it was in operation were situated in a limestone quarry.

Dr. WILLIAM RAMSAY briefly remarked upon the Hargreaves process, and asked for some information about it.

Mr. MAYER said that he had lately been one of a small party who visited some of the chemical works upon the Tyne, including the great establishment of Messrs. Stevenson & Co., over which they had been conducted by the senior partner, and at which the process referred to was in operation. Mr. Stevenson had taken special delight in showing them the very extensive and complete arrangements for successfully carrying out the process, and with it he expressed the utmost confidence. There had been difficulties with it, but he was satisfied that practically they had been overcome, and would in time be entirely overcome.

Mr. MACTEAR stated that the Hargreaves process had already cost Messrs. Stevenson & Co. a sum of £30,000, and that it would probably cost even more; but he felt that the firm would not be likely to give in until they had made it a complete success. He hoped that it would succeed, for it was really a beautiful process. The turning point in reference to it was the question of the economy of fuel, and there was certainly a great saving of fuel effected by the process. Theoretically, there should not be more than 7½ cwts. of coal consumed per ton of sulphate of soda made. In the ordinary process the consumption of coal was 12½ cwts., and in practice he believed it had been reduced to 10 cwts. in the Hargreaves process.

Mr. STANFORD, who had seen that process in operation in company with the inventor himself, considered that it could only be made a perfect success by carrying out improvements in the direction of substituting machinery for hand labour.

A vote of thanks to the author of the paper concluded the proceedings.

NOTICES OF BOOKS.

Elements of Agricultural Chemistry and Geology. By the late Prof. J. F. W. JOHNSTON, of Durham, and C. A. CAMERON, M.D. Tenth Edition. Edinburgh and London: W. Blackwood and Sons.

THE value of Prof. Johnston's work has long ago passed out of the regions of possible doubt, and the fact that ten successive editions have now been called for proves how widely and generally its merits have been recognised. In the present issue the editor, Dr. Cameron, has incorporated with the work the recent advances made in the applications of chemistry and physics to agriculture. In addition to novel facts he has also deemed it advisable to bring forward modern theories and modern nomenclature, the use of which seems more strongly insisted upon in England than in any other European country. Whether in so doing he has acted judiciously is in our humble opinion an open question. We fear that long before the "new nomenclature" has penetrated into the farm and the workshop, it will, in turn, have become "old," and that such tables as that on page 14 will have to be increased from three to four columns, to the ever-growing perplexity of the reader. Concerning this same table we may venture to point out that its accuracy is not unimpeachable. "Soda-ash," and not "washing-soda," is the popular name of "disodic carbonate"—a compound to which Dr. Cameron ascribes the remarkable formula K_2CO_3. "Washing-soda" is generally understood to mean the crystalline salt with 10 equivalents of water. Again "salt-cake" and "Glauber's salts" are not commonly understood to be synonyms, the former being the anhydrous and the latter the crystalline salt. "Hydric calcic oxide" is popularly known as "slaked lime," not as milk of lime, which latter is the name of a mechanical mixture of slaked lime with a variable excess of water. That "salenixum" was a name applied in the middle ages to the bisulphate of soda we are fully aware. But if Dr. Cameron were to go into any dye-works in modern England and ask to see some salenixum, he would assuredly be shown some Glauber's salt. The fact is that popular names, though less subject to change than those involving a theory,—and therefore, in so far, preferable—are not absolutely immutable. We regret having to point out these errors, but it will be at once conceded

that the slightest mistake in what should be an explanatory table, may be of serious consequence to the reader.

The components of the atmosphere we find divided into three groups, headed respectively: *certainly* essential, *probably* essential, and *possibly* essential. The members of the last category are not merely nitric acid, but carbonic oxide, carbonetted hydrogen, sulphuretted hydrogen, and organic matter. On what grounds the four ingredients last mentioned are supposed to be "possibly essential" we are at a loss to conceive. We should be inclined to class them as "probably injurious."

Concerning the effects of different soils upon the quality of the crops—a point which has scarcely met with the attention it deserves—we find the following interesting statement:—"It is a remarkable circumstance that on the London Corn Exchange the dealers seldom buy British peas without first sending a sample to be boiled; whilst foreign peas are generally bought without any trial. They are almost invariably boilers. For split peas, used in making soups and pease-meal, it is obvious that this boiling property is of great importance." The author remarks that "lime and gypsum are said by some to impart the boiling quality, whilst by others exactly the reverse is stated." Now, in connection with this circumstance, we may take the fact that field peas, used when green, are never so sweet and soft as garden peas. The reason we have always heard suggested is that the former grow in soils manured more or less with superphosphate, which is scarcely ever employed in gardens. Now, all superphosphate contains gypsum. If we take water holding sulphate of lime in solution we shall find that vegetables will not boil soft in it, and it seems very probable that the same effect is produced if the sulphate of lime is present not in the water, but in the vegetable. This view harmonises with the superior boiling properties of foreign peas. Abroad, superphosphate has not yet been used as extensively as in England, and the arable soils are therefore less saturated with gypsum. We have heard, also, that English peas have altered for the worse within the memory of persons still living. Several other instances of the influence of soil upon crops are given, presenting a series of most important, but as yet unsolved, problems in agricultural chemistry.

The power of burnt clay to absorb and preserve the droppings of sheep, at once suppressing nuisance and economising the fertilising ingredients, is fully acknowledged. It is strange, however, that sanitary authorities, after reading such evidence, can still deny the value of similar absorbents as applied to human excreta.

In speaking of irrigation the author omits to show—as he might very usefully have done—why irrigation is less prevalent in Britain than in many other countries, and why, if attempted, it could not be so beneficial. The reason is simply this, that there is perhaps no civilised and cultivated country where the rain-fall bears so high a proportion to the average evaporation as in the British islands, and where drought is so uncommon.

It is remarked that "about 7 lbs. of combined nitrogen from rain, snow, and dew are obtained by each acre every year." But is not the nitrogen found in snow simply what has been given off from the soil upon which it has been lying, whilst such as has been collected from a flagged or asphalted court is practically free from nitrogen? As regards the great question whether the free nitrogen of the air is capable of being assimilated by plants or not the author and editor give judgment in the negative. In view, however, of the present researches of Berthelot we can scarcely think the matter decided.

The presence of copper in the ash of plants is stated to be in all probability merely accidental—a proposition which we can scarcely accept when we remember with what regularity it is found, not merely in manufactured cocoas and chocolates, but also in samples of the raw cacao-bean from different localities.

Viewing the book in its present form as a whole, it may safely be pronounced, not merely a treasury of useful information, but a medium for the inculcation of sound and in the highest sense practical, principles. It would be a happy day, not merely for the agricultural interest, but for England in general, if farming were generally carried on in the light of the laws laid down in these pages.

CORRESPONDENCE.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Chemists will not be surprised that I, who do not belong to the Royal Society, nor to the Chemical Society nor even to the Society of Public Analysts, should have declined to join the Institute.

Sympathy with rising English chemists and interest in our science prompts me to publish some of the reasons against the Institute.

In the first place, as every one who has read Mr. Groves's circular will perceive, the formation of the Institute implies the taxation of English chemists at the rate of four guineas a head; and when it is borne in mind that chemical research is almost necessarily unremunerative to the actual worker, and how heavily the resources of chemists are drawn upon by the Chemical and other societies and associations, the proposal still further to tax the English chemist becomes a serious matter. And my object in writing this letter is to give warning that repayment by the benefits arising from the Institute is not to be looked for.

Those chemists who live by analytical work will be aware that the great grievance is not so much that persons utterly ignorant of chemical analysis (persons whom the Institute might possibly exclude) defraud the public and themselves by performing incorrect analysis, but that so much of the work done by presumably competent persons is bad.

For this grievance the Institute cannot provide a remedy, and, under the Institute, the young English chemist, who has worked well and faithfully, and whose work is discredited by the careless place-man, will find himself worse off than before.

The evils under which chemists suffer in this country arise in great measure from the many unfortunate appointments which have been made, from the unhealthy condition of the Chemical Society, and from the want of chemical leaders who command our respect. This condition of things will find its own remedy in course of time; but for the present it is not to be remedied even by Act of Parliament, still less by the formation of a "limited liability company."—I am, &c.,

J. Alfred Wanklyn.

St. George's Hospital, London, W.
January 5, 1878.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—I have read, with perfect accord, the letter of "Well Wisher" in the Chemical News of the 4th inst. (vol. xxxvii., p. 8), and would like to supplement his remarks by stating that there are also chemists in London who have not had any knowledge (except in an indirect and unsatisfactory manner) of the formation of the Institute. I should also like to state that even on making application for information, all that was vouchsafed was a half-sheet of paper with the qualifications required printed thereon, with an *intimation* in writing that details of training, *accompanied by certificates* (the underlining was the secretary's), should be forwarded to the Secretary. This is

not, certainly, an encouraging *invitation* to join the Institute.—I am, &c.,

One of the Affronted.

London, January 7, 1878.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Your corrrespondent "Well Wisher" has, I think, expressed an opinion that is very widely spread when he comments on the fact that a very scanty advertisement is the only notice respecting the closure of admission to the Institute (by the 2nd of February) for applicants under the original foundation. No intimation has been given as to the annual fee to be paid *after* election, though we are informed that 2 guineas is at present the entrance fee. The Institute, it is believed, has been registered as a "limited liability" company. Does any liability attach to the Fellows beyond an annual subscription? It does not follow that limited liability means limited responsibility, and it may be a question with many whether the payment of a 2-guinea entrance fee and an unknown annual subscription is worth the honour with the liability that may attach thereto. So far as any hindrance from the practice of chemistry to those now at work could be given by such "Institute," none need fear. The Medical and Pharmacy acts both respected those in practice, and the Chemical Institute will be no more able to curtail existing rights than the "Sanitary Institute" can interfere with surveyors and engineers.—I am, &c.,

Nemo me impune lacessit.

ACTION OF SUNLIGHT UPON SOLUTIONS OF OXALIC ACID.—NITRIFICATION.

To the Editor of the Chemical News.

Sir,—In his letter in the Chemical News of January 4 (vol. xxxvii., p. 9), Mr. W. N. Hartley states that he has attributed the instability of oxalic acid solutions to the action of a fungus, and from his account it would appear that under some conditions this might be the case. In the solutions, however, which formed the subject of our experiment, no mycelium was observed, the fluid being absolutely clear. Judging, indeed, from our recent observations on the effect of insolation upon certain of the lower fungi, we should not expect to find mycelium developing in solutions exposed to strong sunlight.

We take this opportunity of drawing attention to the interesting bearing of the observations referred to upon the experiments of Schlœsing and Müntz on nitrification. These chemists in February, 1877, communicated to the French Academy a paper proving, in their opinion, that nitrification is due to the action of an organised ferment; and Warington, in a paper lately read before the Chemical Society, added to their observations the important fact that *darkness* is apparently essential to the process.

The explanation of this, which Mr. Warington confessed that he was unable to furnish, may, we think, be found in the fact, elicited by our own experiments, that light is inimical to the development of such organisms; and thus strong collateral evidence is afforded of the truth of the conclusions arrived at by these gentlemen.—We are, &c.,

Arthur Downes, M.D.
Thos. P. Blunt, M.A.

January 5, 1878.

PS.—Your anonymous correspondent, "H P.," is strangely in error in his assertion (Chemical News, January 4th) that Thorpe, in his paper on the carbonic acid in the air of tropical Brazil (*Journ. Chem. Soc.*, 1867), states that he had to abandon the use of oxalic acid solution on account of its rapid alteration of titre in *the strong light of* the tropics. The words in italics are your correspondent's own addition. In Thorpe's origina paper the sentence stands thus:—"Hydrochloric acid was substituted for oxalic acid in the titration of the baryta water, since solutions of the latter acid decompose rapidly in the tropics." Not a work is said about light, and there is no further allusion to the subject.

Of course it is well known to chemists that the standard solution of oxalic acid is unstable, and most of us have, for that reason, abandoned its use.

A. D., T. P. B.

AMMONIA IN FILTERED WATER.

To the Editor of the Chemical News.

Sir,—Having occasion about a year ago to test the powers of a "spongy iron filter," I was struck by finding the quantity of free ammonia in the filtrates much greater than could have proceeded from the destruction of the organic matter, plus original free ammonia in the waters used for the experiments; but, on reflection, the source of the excessive free ammonia was obvious. I do not, however, think that any chemist would be likely to condemn a water because of excessive free ammonia found under such conditions. I may say that in no case did I find the tremendous quantity of ammonia obtained by Mr. T. Jones. I found also in these experiments that some of the filtrates had a metallic taste, but as the filtered water was generally more or less turbid, this was no doubt due mainly to iron in suspension—particles of the filtering medium washed through. I had not, unfortunately, the opportunity for thoroughly investigating everything connected with this strange filter.—I am, &c.,

Harold H. Slater.

January 7, 1878.

AMMONIA IN FILTERED WATER.

To the Editor of the Chemical News.

Sir,—I think Mr. T. Jones will find that the following quotations explain the phenomenon he describes:—"It is, however, quite certain that there is also a reducing action taking place when ordinary water is passed through spongy iron. This is clearly indicated by the reduction of nitrates (Chem. News, vol. xxxvi., p. 3). Spongy iron reduces nitrates and nitrites, converting only a small portion of their nitrogen into ammonia. (*Sixth Report of the Rivers Commission*, p. 220).

The well water examined by Mr. T. Jones must have contained a very large amount of nitrates and nitrites to give so much ammonia.—I am, &c.,

B. J. Grosjean.

J. B. Lawes's Chemical Works, Millwall, E.
January 9, 1878.

NATURE'S HYGIENE.

To the Editor of the Chemical News.

Sir,—In the Chemical News of the 28th of December, 1877 (vol. xxxvi.,p. 283), in a review of a pamphlet entitled "Nature's Hygiene and its Artificial Imitation," the following remark occurs:—"Before explaining the mysterious agency of certain plants and trees, would it not be well first to place beyond a doubt the existence of such an agency, and to ascertain its conditions and limits?"

I believe that an inquiry directed to this end, and properly conducted, would be of infinite value to real sanitary science, and would do much to dissipate some mischievous delusions. As bearing on such an enquiry, I shall be glad if you will allow me to mention two cases which occur to me, in which trees seem to have affected, in a marked manner, the health of the population in their immediate neighbourhood,

The cantonment of Gorukpore, in North-west India, though near the forest and in the neighbourhood o a

large swamp, was, some 30 years ago, considered a healthy station. A large grove of mango trees existed between the swamp and the station. For some reason this grove was cut down, and the station became unhealthy. I think I have heard that the trees having been replanted the station has again become healthy.

The other case is that of the Civil station of Futtehpoor, situated between Allahabad and Cawnpoor, in an arid plain, but near a somewhat extensive marsh. This place was considered extremely unhealthy until the Magistrate, who was, I think, the present Sir William Muir, planted between the station and swamp a belt of the quick-growing babool tree. As the trees grew the place became much less unhealthy.

I believe that I have correctly stated the facts in the cases mentioned, and if so, it would appear that the trees acted as screens or filters, and so protected the population from the effect of the malaria generated in the swamps beyond them.

I may mention that it would be difficult to find trees with more dissimilar foliage than the mango and the babool.

Is it not probable that where beneficial effects have followed the planting of the Eucalyptus, they may be due as much to the screen which the plantation has interposed as to any peculiar or specific action of, or exhalation from, the leaves or stem of the tree?

The often-quoted case of the Trappist Monastery at Tre Fontane, near Rome, does not seem to be evidence of the peculiar virtue of the Eucalyptus. There is, unhappily, no doubt that the place was fatal to human life. Of the Trappist monks who were sent, some few years ago, to re-occupy the site, not one, I believe, survives; but their numbers were recruited, they persevered, and the ground around has now been deeply cultivated; 700 cartloads of human bones have been removed. (The place was the execution ground and burial place for criminals of old Rome.) A vineyard has been planted, young Eucalypti are growing round the garden, and doubtless the air is somewhat less deadly. It is not easy to determine how much of the improvement is due to the screen of the Eucalypti and how much to the other operations. The monks believe in the Eucalyptus. They make what they call an "elixir" of the leaves for sale, and, I was told, take a dose of the elixir every morning before eating anything.

As I am not inclined to enter into any controversy, I hope if you print this letter you will allow me to sign myself merely

A Reader of the Chemical News.

January 5, 1878.

STOP-COCK FLASK.

To the Editor of the Chemical News.

Sir,—In the Chemical News of January 4, 1878 (vol. xxxvii., p. 7), Dr. Corfield figures and describes an apparatus which he calls a "stop-cock flask," but which appears to me to be only a particular form of a separating funnel.

The idea of separating fatty acids in a flask is, however, not new. If Dr. Corfield turns to the *Analyst* of October, 1877, he will find a paper there by the present writer, entitled "Easy and Rapid Method of Manipulating Fatty Acids," in which is described an adaptation of Mohr's well-known flask, figured at p. 130 of his "Chemische Toxicologie," Braunschweig, 1874. My flask is about 350 c.c. capacity; it has a long and narrow neck, and a doubly perforated cork or stopper; the cork carries two tubes, the one reaching nearly to the bottom of the flask, and bent externally in a syphon form, its use being to let in the air; the other provided with a stop-cock to let out the liquid on the inversion of the flask. The fat is saponified, the soap decomposed, and the fatty acids washed and separated, all in the same flask. There is no transference of the liquid from one vessel to the other. The materials are in every one's laboratory, and the method is, I believe, superior to that advocated by Dr. Corfield.

With regard to the drying of the fatty acids, I find it most convenient, as recommended by Mr. Jones (*Analyst*, May, 1877), to pour the melted fatty acids into a porcelain dish, dissolving every trace from the flask with ether.—I am, &c.,

A. Wynter Blyth.

Barnstaple, January 5, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 25, December 17, 1877.

Reproduction of the Sulphide, Selenide, and Telluride of Silver in a Crystalline State, and of Filiform Silver.—M. J. Margattet.—Silver, gold, and occasionally copper, are met with in nature in filaments, the appearance of which recalls that of a metal passed through a wire-drawing apparatus. These three metals may be artificially obtained by the dry way in this filiform condition on reducing their sulphides, selenides, and tellurides with hydrogen. The author obtains crystalline sulphide by passing the vapour of sulphur, carried slowly along by a current of hydrogen over silver at a dull red heat. As soon as the sulphur comes in contact with the silver, the latter is covered with crystals of silver sulphide, which increase in size and number until the silver is completely sulphuretted. The current of sulphur must be very slow. The composition and the physical properties of the artificial product are the same as those of the native sulphide, AgS. Its form is that of a rhomboidal dodecahedron. The selenide and telluride of silver are obtained in an analogous manner. The former is steel-grey and very brilliant, and crystallises in the regular system in the form of a rhomboidal dodecahedron. Silver telluride is black, and is obtained in chaplets of regular octahedra, united by their summits. Crystalline silver sulphide is entirely converted into filiform metallic silver by a current of dry hydrogen at a temperature of 440°. Metallic silver appears at the outset of the operation in the form of small tufts implanted on the surface of the crystals of sulphide; as the reduction continues these tufts become threads, which increase in length and thickness at the expense of the silver continually set at liberty by the hydrogen. After some time they present the aspect of ribbons twisted in a spiral, mixed with small threads of extreme fineness, the whole supported by crystals of sulphide which have preserved their original form. The silver liberated presents no trace of a crystalline texture. The specimens thus obtained closely resemble the native associations of crystalline silver sulphide and of filiform silver so often met with. The selenide and telluride of silver yield also filiform metallic silver, but the reduction only sets in at a higher temperature.

Use of the Lakes of Eosin and Fluorescein for the Preparation of Decorative Paintings Without Poison.—M. E. Turpin.—A solution of the potassic or sodic eosin of commerce, treated with an acid, yields a precipitate of eosic acid, insoluble in water. This precipitate, if washed until the water begins to turn rose-colour, is insoluble in the hydrate of the oxide of zinc, and forms thus a very rich lake, which may vary from a rose to a deep red, according to the quantity of eosic acid employed. This acid, dissolved in a solution of sodic car-

bonate and precipitated with potash-alum, likewise gives a very rich lake. These lakes resist elevated temperatures and sulphurous emanations, and may be used in the colouration, in the mass, of vulcanised india-rubber, withstanding perfectly the degree of temperature required for vulcanisation and the disengagement of sulphuretted hydrogen which ensues during the reaction. The colours obtained with these lakes are in this case incomparably finer than the shades obtained with mercuric sulphide (vermilion) and antimonic sulphide, and may serve as substitutes for these colours in painting, and have the advantage of being harmless. Pure fluorescein likewise forms a yellow lake with hydrated zinc oxide. If eosin and fluorescein are employed conjointly they yield lakes capable of replacing the reds and oranges obtained from lead, as minium, orange minium, &c. Zinc chromate, if treated with a potassic solution of eosin and the eosic acid liberated by the addition of alum, yields, on evaporation to dryness, lakes remarkable for the brightness of their shades, which may range from a pale yellow to a lively red, and which may serve as substitutes for the poisonous chromates of lead. These products, although attacked by water, may be advantageously employed in painting, for they are absolutely indecomposable by oils and essences, cover well, and can be prepared cheaply. With the aid of these new colours and certain others, the author has reproduced approximately, with-non-poisonous colours, the chromatic table of M. Chevreul.

Action of the Oxychloride of Carbon upon Toluene in presence of Aluminic Chloride.—MM. E. Ador and J. M. Crafts.—The authors find that in consequence of this action hydrogen is removed not from the methyl group but from the radical C_6H_5, aceton being obtained as a final product.

Remarks on the Action of Stable Anhydrous Acids upon Stable Anhydrous Bases: Explosion of the Compound.—MM. E. Solvay and R. Lucion.—The authors observe that a mixture of anhydrous phosphoric acid with anhydrous oxide of sodium may remain without reaction at the ordinary temperature, but an elevation of temperature to 100° determines instant combination with remarkable violence, amounting in one instance to explosion. This instantaneous character of the combination excludes, they consider, the hypothesis of the presence of a trace of water in M. Béchamp's experiments on the same subject. M. Lucion objects, however, to the inference drawn by M. Béchamp from these phenomena.

Maturation and Diseases of the Cheese of the Cantal.—M. E. Duclaux.—The principal fact in the ripening of the cheeses of Cantal, and, without doubt, of many others, is the gradual transformation of the casein insoluble in water into two albumens soluble in that liquid. The large amount of water in Cantal cheese (45 per cent) gives opportunity for the sugar of milk remaining in the curd to undergo fermentation, sometimes alcoholic, more commonly lactic, with a great tendency to become butyric.

Measurement of the Diedric Angles of Microscopic Crystals.—M. Em. Bertrand.—Not suitable for abstraction.

Preparation of Alcoholic Chlorides, and their Application to the Production of Colouring Substances.—MM. P. Monnet and F. Reverdin.—The green colouring matter known in commerce under the name of methylaniline green was prepared hitherto by causing the nitrate of methyl to act upon an alcoholic and alkaline solution of methylaniline violet. The facts which the preparation and the industrial employment of methyl-nitrate present have led the authors to search for another method. They have, since March, 1874, caused methyl chloride to act upon methylaniline violet in an alkaline alcoholic solution. They produce methyl chloride by heating a mixture of one molecule of methylic alcohol and one molecule of hydrochloric acid (commercial acid at 23° B.) to 100° in a closed autoclave for several hours. The pressure rises to 30—35 atmospheres. The product of the reaction, distilled with an alkali, is filtered to separate the base of the violet; the filtrate containing the base of the green is then treated with an acid and a salt of zinc to form the corresponding double salt of aniline-green and of zinc, and the colouring matter is then precipitated by means of common salt. If rosaniline is substituted for methylaniline violet, we obtain the colouring matter known as Hofmann's violet, hitherto prepared by the action of methyl iodide upon rosaniline hydrochlorate. What has been said of the preparation of methyl chloride applies equally to the preparation of the other chlorides of alcohol radicals, modifying the conditions of pressure and temperature. Ethyl chloride acts in the same manner as methyl chloride upon methylaniline violet and upon rosaniline hydrochlorate, and is prepared under the same conditions. The yield of ethyl chloride is 60 per cent of the theoretical quantity.

Bulletin de la Societe Chimique de Paris,
No. 12, December 20, 1877.

Thermic Formation of Isomeric Bodies.—M. Berthelot.—The experiments described, which have been extended to about thirty compounds, including alcohols, aldehyds, fatty acids and their salts, acid chlorides and bromides, sulpho-conjugated acids, &c., conduct to this important conclusion: isomeric bodies of the same chemical function are formed from their elements with disengagements of heat almost equal; thus their reciprocal metamorphosis liberates very little heat. Finally, the same relations exist in the formation of their isomeric derivatives.

New Remarks on the Quantities of Heat Liberated on Mixing Water with Sulphuric Acid.—M. Berthelot.—Already noticed.

Limits of Etherification.—M. Berthelot.—The experiments described verify the general laws of etherification, and especially the identity of the limits of combination between the acids and the alcohols from the ordinary temperature up to 260°.

Heat Liberated by Chemical Combinations in the Gaseous State: Anhydrous Acids and Water.—M. Berthelot.—A thermo-chemical study of the synthesis of nitric acid. The author remarks that the reactions which he describes, so simple for those who write water HO, and the anhydrous acids NO_5 and $C_4H_3O_3 = 2$ vols. become complicated in the atomic notation. It is not one of the smallest inconveniences of this notation to have made disappear from the science the simple notion of anhydrous acids and anhydrous bases; that is to say, to suppress or complicate an entire order of positive facts and of relalations given by experience, because the new language was unable to express them.

Researches on Chloral and on its Hydrate.—M. Berthelot.—There is liberation of heat in the reaction of gaseous chloral upon gaseous water with formation of a gaseous compound. The gaseous hydrate of chloral exists then veritably as a compound distinct from a mere mixture of the two vapours. This conclusion is conformable to the results obtained by M. Troost from the study of the tensions of dissociation. It is supported by this fact that anhydrous chloral does not combine instantaneously with water, but condenses in it first in the form of an oil which only dissolves by degrees even on agitation; whilst, on the contrary, chloral hydrate in vapour condenses under water in the state of a crystalline hydrate, if not agitated, and dissolves at once on stirring.

Physical Properties of Quercite.—L. Prunier.—An account of the crystalline form, rotatory power, specific gravity, and solubility of this compound.

Synthesis of Indol.—M. Maurice Prudhomme.—In 1873 the author obtained indol by setting out from the bases obtained by Hofmann by the action of bibromide of

ethylen upon aniline. If the crude product of this reaction is distilled with zinc powder it gives the odour characteristic of indol and of indigo.

Russian Chemical Society.—Session of Sept. 8/20 and Oct. 6/18, 1877.—Noticed elsewhere.

Determination of Albumen in Serum and in Milk.—J. Puls.—To determine albumen in serum the author acidulates the acetic acid and adds alcohol till the mixture contains 70 per cent. of the latter. He boils and washes the precipitate first with alcohol at 70 per cent. and then with absolute alcohol. The precipitate is dried, weighed, incinerated, and the weight of the ash is deducted from the weight of the dry matter. The alcoholic filtrate is free from albumen. The author has found in seven experiments quantities of albumen varying from 7·92 to 7·99 per cent. In cows' milk he has found 3·40 to 3·43 of albumen, and has ascertained that milk-sugar is soluble in alcohol, and therefore does not affect the results. Woman's milk contains 0·95 per cent. of albumen. —*Pflüger's Archiv.*, xiii., 476.

Use of Ferrocyanide in Electro-gilding.—Ed. Ebermayer.—In a capsule holding 4 litres are dissolved 300 grms. ferrocyanide, 100 grms. carbonate of potash, and 50 grms. sal-ammoniac. On the other hand, 100 grms. of gold are dissolved in aqua-regia, the excess of acid driven off, and the chloride of gold dissolved in water so as to make up 1 litre. Of this liquid, 200 c.c. are added, little by little, to the ferrocyanide solution; the mixture takes a blue colour, which disappears gradually on boiling, whilst ferric oxide is precipitated. The liquid is let cool, filtered, and made up to 5 litres. This is the gilding-bath. As it is a bad conductor and deposits ferric oxide upon the anodes, the author adds a small quantity of cyanide, not sufficient, however, to evolve hydrocyanic acid on boiling, The gilding is performed at 40° to 50°. When the bath no longer gives a good deposit 200 c.c. of the solution of chloride of gold are again added in the same manner, continuing thus till all the gold is consumed. But if the bath is to be used for still further quantities of gold 1-10th of the quantity of salts directed above must be added to the bath. To recover the gold remaining in the bath when no longer fit for gilding, the author precipitates it electrolytically upon a plate of copper, but it requires to be refined. The object of the process is to avoid the use of large quantities of cyanide of potassium, so objectionable from a sanitary point of view.—*Dingler's Polytech. Journal.*

Use of Chlorhydrin in Tanneries.—M. Sedlon.—Since Knapp showed that the yelk of egg acts principally by means of the emulsified oil which it contains attempts have often been made to substitute other oils in a finely divided state. The author proposes for this purpose an emulsion of oil of chlorhydrin, prepared by the reaction of glycerin and hydrochloric acid.—*Dingler's Polytech. Journal.*

Reimann's Färber Zeitung,
No. 45, 1877.

Pollution of Rivers Extraordinary.—It appears that on November 10 7 cwts. of arsenic were plunged into the Rhine by the sinking of a vessel between Vallendar and Bendorf. The daily papers, so anxious as regards dyes supposed to contain traces of arsenic, take this accident very cooly.

No. 46, 1877.

Part Played by Milk of Sulphur in Dyeing.—This interesting paper has been already noticed in the proceedings of the German Chemical Society.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 12, November 22, 1877.

The *Revue Allemande* denounces the use of arsenic, not in dyes, but in mordants and mixtures used in finishing cotton goods, and which sometimes contain arseniate of soda to the extent of one-sixth part of their weight.

No. 13, November 29, 1877.

This issue contains no original chemical matter.

MISCELLANEOUS.

The Telephone.—At the meeting of the Medical and Physical Society here to-day, Professor Fick exhibited the action of telephonic sounds on the muscles of frogs. The two ends of the telephone wires are placed in contact with the leg muscles of the frog, and the operator speaks into the telephone. The production of the sounds *a*, *e*, *i* has scarcely any raneïc effect; whilst *o*, and especially *u*, produce a most violent convulsion, although spoken much more faintly than the *a*, *e*, *i* sounds. The pronunciation of the word "*Zucker*," even in a low tone, causes the preparation to jump, whilst the very loudly-spoken command, "*liege still*," has a scarcely sensible effect.

W. R. H.

Würzburg, Jan. 5, 1878.

Russian Scientific News.—The excellent invention of M. Jablochkoff was recently illustrated in a lecture on electric light by Mr. Tchikaleff, in the Russian Technical Society. It appears that the electric candle, in order to be properly managed, requires magneto-electric machines, with a changeable current, which are far dearer than machines with constant current. A candle 0·12 metre long will burn 30 minutes, giving a light equal to 250 candles (normal), and costs 50 centimes, so that a light of 1000 candles during one hour costs 4 francs, besides the cost of working the machine. In using an ordinary regulator the same intensity of light may be obtained by burning 0·1 metre of coke-stick, which costs 2½ centimes. The lighting of the Palais d'Industrie in Paris by Jablochkoff's candles would cost 600,000 francs, instead of 50,000 francs, the cost of the ordinary regulator arrangement for the same purpose. However ingenious is this invention, there is much yet to be done in order to adapt this system for practical use.

M. Gesechus is engaged in some experiments on the action of hydrogen on the co-efficients of elasticity of palladium, and of the alloys of silver and gold with palladium. The experiments proved that the coefficients of elasticity diminish during the absorption of the hydrogen by the wires; the strongest effect was remarked during the use of palladio-silver wires (75 per cent of Pd, 25 per cent of Ag). Before and after the evolution of hydrogen the coefficients of elasticity were remarked to be the same.

Prof. Petrouchevsky is in the course of studying the moon photometrically. Several instruments devised by him are nearly ready. As a unit of light in his researches, the Professor desires to use the light of the full moon; in using such a unit, and comparing the light of different places on the moon with the light of the area of the moon, the changes in lucidity of our own atmosphere will have no serious action on the photometric observations. During the phases he will use Zollner's comparative tables. The apparatus of Prof. Petrouchevsky differ much from the apparatus of M. Vogel, used by him during his last elaborated researches on the absorption of light by the solar atmosphere.

The Graham-Bell telephone is here also the great attraction of the day. Several firms are now selling this instrument, but the price is rather too high (£1). The simplicity of this ingenious invention is indeed astonishing. The diffusion of another very useful invention, the "electric pen," which is well known in England, is much checked by Government regulations, as the use of printing implements for private use is strictly forbidden in this country.

S. Kern, M.E.

St. Petersburg.

THE CHEMICAL NEWS.

VOL. XXXVII. No. 947.

LIQUEFACTION AND SOLIDIFICATION OF HYDROGEN.

M. RAOUL PICTET telegraphs from Geneva as follows:—"Geneva, January 11th, 10.30 a.m. I have liquefied hydrogen at 650 atmospheres and 140 degrees of cold. It solidifies by evaporation. Intermittent jet of a steel-blue colour. Violent projection, like small shot, on the ground, with a very characteristic harsh shrill sound. Hydrogen retains the solid state in the tube for several minutes."

We read in the *Journal de Genève* that on Thursday evening, January 10th, M. Raoul Pictet succeeded in liquefying hydrogen gas in the laboratories of the Society for the Construction of Physical Instruments, at Plainpalais.

The experiment, which was performed in the presence of several people, succeeded perfectly. The process consists in decomposing formiate of potash by caustic potash, a reaction which, as proved by M. Berthelot, gives hydrogen absolutely pure. The pressure commenced to rise at half-past eight; gradually and without any stoppage it attained, at seven minutes past nine, 650 atmospheres, at which point it remained steady for a few instants. At this moment the tap was opened, and a steel-blue jet escaped from the orifice, producing a hissing sound like a bar of red-hot iron plunged into water.

The jet suddenly became intermittent, and there could be observed a hail of solid particles projected violently to the ground, on which their fall produced a crackling noise. The tap was closed, and the pressure, which was then at 370 atmospheres, gradually descended to 320, where it remained for some minutes. It then rose to 325. At this moment the tap, on being opened a second time, only allowed a jet to escape intermittently, rendering it evident that a crystallisation had taken place in the interior of the tube. The proof of this can be established by the escape of hydrogen in the liquid state when the temperature begins to rise on stopping the pumps.

Thus has been experimentally demonstrated the liquefaction, and especially the solidification, of this gas, which from its properties has always been considered probably to belong to the class of metals.

METALLURGICAL NOTES.

By SERGIUS KERN, M.E. St. Petersburg.

I. ON CERTAIN GOLD ALLOYS.

THE author having analysed, some time ago, several gold alloys, obtained by melting crude gold direct from the mines, thinks that some remarks referring to these alloys may be of interest.

The aspect of these alloys presented nothing particular. Under the microscope a rather crystalline structure was observed.

When forged the specimen plates prepared from these alloys tore easily; indeed they were very brittle.

The analysis of these alloys are as follows:—

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.
Gold	99·46	99·280	98·50
Silver	0·52	0·640	1·48
Lead	traces	0·005	traces
Copper	0·01	0·070	0·01
Bismuth	0·01	0·005	0·02

The alloy No. 2 could be hammered in the cold, but on being forged in a heated state it fell to pieces.

	No. 1. Per cent.	No. 2. Per cent.
Gold	94·20	96·75
Silver	5·76	3·17
Iron	traces	none
Copper	0·01	0·06
Lead	0·01	0·01

A certain quantity of these alloys, well washed, in a divided state, in nitric acid, and refined by cupellation, was fused into ingots in a gas-furnace. The ingots obtained showed no brittleness whatever, and forged very well. The analysis detected no presence of lead, bismuth, or iron.

These results confirm the elaborate experiments of Mr. Chandler Roberts, who showed that even traces of lead, antimony, bismuth, or arsenic impart brittleness to gold alloys (*Dingl. Journ.*, 1871). The author can give no decided opinion on the action of traces of arsenic on gold alloys, as in specially prepared alloys which were found to contain notable traces of arsenic no brittleness was remarked.

It must be mentioned, however, that gold alloys containing 0·05 to 0·08 per cent of arsenic could not be readily worked under the hammer.

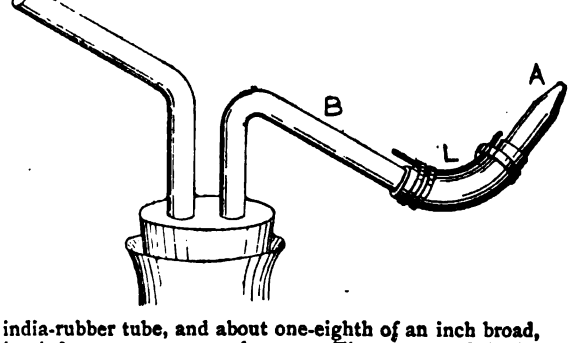
II. ON DEMIDOFF'S IRON.

In an English journal the author found a statement that the Russian iron from Demidoff's works, at Nischnetagilsk (Oural Mountains), is indebted for the peculiar qualities to the phosphorus it contains (*Journ. Soc. Arts*, No. 1239, p. 901). The mark of this iron is CCND. All the iron prepared at the above-mentioned works is manufactured from the best Oural iron-ores, free from phosphorus and sulphur. Sulphur is indeed sometimes found as traces, but phosphorus never. The resulting iron is well known in Europe. It is so pure and soft that by rolling it in ordinary rolling-mills sheet iron is obtained a square inch of which weighs only 0·130 grm.

MOVABLE JET FOR WASH-BOTTLE.

By C. J. WOODWARD.

INSTEAD of the arrangement figured in Thorpe's "Analysis" I have used the following form of movable jet, which enables the operator to direct a stream of water in any required direction. The jet, A, is attached to the tube, B, by a piece of india-rubber tubing, a sufficient space being left between the two tubes for A to play about in any direction. A strip of sheet lead, somewhat longer than the



india-rubber tube, and about one-eighth of an inch broad, is tied on as represented at L. Thus arranged the jet may be turned about, and the strip of lead retains the jet in whatever position it is placed. It is an advantage to fasten that end of the lead near the jet, A, with a band, as this can easily be slipped off if it be desired to use the jet without the lead attachment.

Birmingham and Midland Institute.

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.

By H. CARRINGTON BOLTON.

(Continued from p. 14).

V. SILICATES.

Mineral.	Formula.	Description.	Locality.
Wollastonite.....	$\dot{C}a\ddot{S}i$	fibrous.....	Natural Bridge, N.Y.
Diopside.....	$(\dot{C}a\dot{M}g)\dot{S}i$	crystals	Tyrol.
Augite.....	$(\dot{C}a\dot{M}g\dot{F}e)(\ddot{S}i\ddot{A}l\frac{2}{3})$	crystals	Sicily.
Rhodonite	$\dot{M}n\ddot{S}i$	massive	Franklin, N. .
Spodumene	$\dot{R}^3\ddot{S}i^3+4\ddot{A}l\ddot{S}i^3$	crystals	Windham, Me.
Hornblende	$(\dot{R}\dot{R})(\ddot{S}i\ddot{A}l\frac{2}{3})$	massive	New York City.
Chrysolite	$(\dot{M}g\dot{F}e)^3\ddot{S}i$	massive	North Carolina.
Olivine	$(\dot{M}g\dot{F}e)^2\ddot{S}i$	granular.....	Sandwich Islands.
Willemite	$\dot{Z}n^2\ddot{S}i$	massive	Franklin, N.J.
Almandite	$(\frac{1}{3}\dot{F}e^3+\frac{2}{3}\ddot{A}l)^3\ddot{S}i^3$	crystals	Sterling, N.J.
Epidote	$[\frac{1}{3}\dot{C}a^3+\frac{2}{3}(\ddot{A}l\dot{F}e)]\ddot{S}i^3$	massive	Ducktown, Tenn.
Biotite	$\frac{1}{2}(\dot{M}g\dot{K})^3+\frac{1}{2}(\ddot{A}l\dot{F}e)^3\ddot{S}i^3$	laminæ	Westchester Co., N.Y.
Muscovite	$(\dot{R}^3\ddot{R})_2\ddot{S}i^3+\frac{1}{2}\ddot{S}i$	laminæ	North Carolina.
Wernerite	$[\frac{1}{3}(\dot{N}a\dot{C}a)^3+\frac{2}{3}\ddot{A}l]^3\ddot{S}i^3+\ddot{S}i$	massive	Gouverneur, N.Y.
Labradorite	$[\frac{1}{4}(\dot{C}a\dot{N}a)^3+\frac{3}{4}\ddot{A}l]^3+\frac{3}{4}\ddot{S}i^3$	massive	Turin, N.Y.
Albite	$(\frac{1}{4}\dot{N}a^3+\frac{3}{4}\ddot{A}l^3\ddot{S}i^3+6\ddot{S}i$	massive	Yancey Co., N. C.
Orthoclase.....	$(\frac{1}{4}\dot{K}^3+\frac{3}{4}\ddot{A}l^3\ddot{S}i^3+6\ddot{S}i$	massive	New York City.
Chondrodite	$\dot{M}g^3\ddot{S}i^3[Fl]$	crystals	Sparta, N.J.
Tourmaline	$(\dot{R}^3\ddot{R}\ddot{B})^3\ddot{S}i^3[Fl]$	black crystals.....	New York City.
Kyanite	$\ddot{A}l\ddot{S}i$	crystals	Buncombe Co., N.C.
Datolite	$(\dot{C}a^3\dot{H}^3\ddot{B})\ddot{S}i$	crystals	Lake Superior.
Pectolite.....	$(\frac{2}{3}\dot{C}a+\frac{1}{3}\dot{N}a+\frac{1}{3}\dot{H})\ddot{S}i$	crystals	Bergen, N.J.
Chrysocolla	$\dot{C}u\ddot{S}i+2\dot{H}$	massive	Lake Superior.
Calamine	$\dot{Z}n^2\ddot{S}i+\dot{H}$	crystalline	Friedensville, Pa.
Prehnite.....	$(\frac{1}{2}\dot{H}^2+\frac{1}{2}\dot{C}a^2+\frac{2}{3}\ddot{A}l)^3\ddot{S}i^3$	uniform, massive	Scotland.
Apophyllite	$[\frac{1}{3}\dot{H}+\frac{1}{3}(\frac{1}{3}\dot{K}+\frac{2}{3}\dot{C}a)]^3\ddot{S}i+\dot{H}\ddot{S}i$	crystals	Bergen, N.J.
Natrolite (1)	$3\ddot{S}i,\ddot{A}l,\dot{N}a,2\dot{H}$	dark, massive	Wurtemberg.
,, (2)		white, fibrous	Bergen, N.J.
Analcite.....	$4\ddot{S}i,\ddot{A}l,\dot{N}a2\dot{H}$	fine crystals	Lake Superior.
Chabazite	$4\ddot{S}i,\ddot{A}l[\frac{1}{3}\dot{C}a+\frac{1}{3}(\dot{N}a\dot{K})]6\dot{H}$	crystals	Nova Scotia.
Stilbite	$6\ddot{S}i.\ddot{A}l,\dot{C}a,6\dot{H}$	crystals	Nova Scotia.
Talc	$(\frac{1}{2}\dot{H}+\frac{1}{2}\dot{M}g)\ddot{S}i$	massive	North Carolina.
Serpentine	$\dot{M}g_2\ddot{S}i+\dot{H}$	massive	Newburyport, Mass.
Retinalite	$\dot{M}g_2\ddot{S}i+\dot{H}$	waxy translucent.....	Montville, N.J.

Mineral.	Formula.	Description.	Locality.
Chrysotile	$\dot{\dot{M}}g_2Si+H$	silky, fibrous	Montville, N.J.
Deweylite	$(\frac{3}{4}\dot{\dot{M}}g+\frac{1}{4}\dot{H})^3Si+\frac{1}{2}\dot{H}$	massive, translucent ..	Rye, N.Y.
Ripidolite	$8(\frac{3}{4}\dot{\dot{M}}g^3+\frac{1}{4}\dot{\dot{A}}l\dot{\dot{F}}e)2Si,12\dot{H}$	laminæ	North Carolina.

[NINETY SPECIES, ONE HUNDRED AND TWENTY SPECIMENS.]

(To be continued).

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 11, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

"*Note on Metallic Niobium and a New Niobium Chloride,*" by Professor H. E. ROSCOE, F.R.S., &c.

The history of the investigation of the two closely related metals niobium and tantalum is of interest as showing how step by step the difficulties and uncertainties which surround the examination of analogous and rare substances such as these are overcome; and I may therefore be allowed shortly to state the growth of our knowledge on this subject.

In the year 1801 Hatchett discovered a new metal in the mineral columbite from Massachusetts, and to this he gave the name of columbium. Ekeberg a year later found a similar new metal in a rare Swedish mineral, and to it he gave the name tantalum. Wollaston, in 1809, came to the conclusion that these two metals were identical. Berzelius next examined the metal contained in the Swedish tantalite, and afterwards Wöhler found these metals in several other minerals. Heinrich Rose next investigated this subject, but in spite of persistent effort the results of his experiments left the matter in a still less satisfactory condition, inasmuch as he first came to the conclusion that two more new metals were contained in these minerals, to which he gave the names of niobium and pelopium, whilst at a later period he decided that both niobic and pelopic acids were different oxides of the same metal, for which he proposed the names niobic and hyponiobic acids.

Then, again, in 1860, Von Kobell thought that he had found a fourth new metal, which he called dianium, in the same minerals, and Hermann believed that he had discovered in them a fifth metal, to which he gave the name ilmenium. It is to Marignac and Bloomstrand that we owe a deliverance from this state of contradiction and uncertainty. They independently proved that only two metals in reality exist—niobium and tantalum—and that these are present in varying proportion in most of the minerals in question. They showed that the compounds derived from Rose's niobic oxide contain mixtures of niobic and tantalic oxides, whilst his hyponiobic oxide is pure niobic oxide.

Bloomstrand arrived at this result by a series of analyses of the chlorides. He proved that the white hyponiobic chloride of Rose is in fact an oxychloride, whilst the yellow niobic chloride contains no oxygen.

Marignac, on the other hand, came to a similar conclusion by an investigation of the fluorides of niobium and tantalum, and pointed out that the oxides are pentoxides, Nb_2O_5 and Ta_2O_5, whilst the niobium chloride and oxychloride are represented respectively by the formulæ $NbCl_5$ and $NbOCl_3$.

All the other supposed metals turned out to be either simple mixtures of these two in varying proportions, or such a mixture containing in addition some other metal, such as tungsten, titanium, or iron.

Troost determined the vapour densities of niobium pentachloride and oxychloride, obtaining the numbers 9·6 for the first and 7·87 for the second, agreeing closely with the calculated densities when the atomic weight of niobium is taken to be 94.

Some time ago I obtained several crystals of Greenland columbite which possessed a specific gravity of 5·389 and which contains, as Marignac has shown, little or no tantalum. From this material I prepared nobium pentoxide (Nb_2O_5), niobium pentachloride ($NbCl_5$), and niobium oxychloride ($NbOCl_3$) by well known methods.

I have likewise prepared metallic niobium and a new chloride of niobium. The results of these experiments are contained in the following communication.

The following results of analysis of the pentachloride and oxychloride serve to show the purity of the material

	Pentachloride. Calculated.	Found.
Niobium	34·62	34·38
Chlorine	65·38	65·55
	100·00	99·93

	Oxychloride. Calculated.	Found.
Niobium	43·42	42·93
Chlorine	49·19	49·34
Oxygen (Diff.)	7·39	7·73
	100·00	100·00

Metallic Niobium is difficult to prepare, and precautions, similar to those employed for the preparation of metallic vanadium, must be taken. It is obtained as a bright steel-grey, shining, metallic crust by passing the vapour of the pentachloride mixed with hydrogen repeatedly through a red-hot glass tube. The metallic crust, then deposited on the side of the tube, is next strongly ignited in a porcelain tube in a current of hydrogen until no further evolution of hydrochloric acid occurs.

In order to avoid as completely as possible access of traces of oxygen, the very hygroscopic pentachloride was prepared in a narrow tube, and this was transferred bodily into the wider tube, in which the preliminary heating with hydrogen takes place.

The metal thus obtained was analysed by placing a weighed quantity in a porcelain boat and heating it in a glass tube in a current of air. The metal takes fire and burns brightly to the pentoxide, a small trace of oxychloride being usually deposited, existing as impurity in the metal. In one instance when the metal was allowed to oxidise very slowly, the formation of an indigo-blue-coloured lower oxide was first observed; this afterwards passed into the yellow pentoxide on further heating.

The following analyses were made with metal obtained in two distinct operations:—

I. Weight of metallic niobium taken .. 0·3963 grm.
„ niobium pentoxide obtained .. 0·5480 „

This corresponds to 0·3810 of metal; or the substance contains 96·14 per cent of niobium.

II. Weight of metallic niobium taken .. 0·3900 grm
„ niobium pentoxide obtained .. 0·5403 „

This corresponds to 0·3790 of metal; or the substance contains 97·18 per cent of niobium.

That the substance thus prepared is not, as has been supposed, a hydride, is shown by the fact that the second of the above specimens on analysis was found to contain only 0·27 per cent of hydrogen.

Metallic niobium possesses a steel-grey colour and bright metallic lustre. It is remarkable that it is not attacked in the cold by hydrochloric or nitric acids, either dilute or concentrated, or even by *aqua regia*. Strong sulphuric acid, on the other hand, dissolves the metal quickly, yielding a colourless solution. The metal does not take fire in chlorine gas at the ordinary temperature, but it does so when gently heated, with formation of pentachloride and a trace of oxychloride, owing to the unavoidable presence of a small quantity of oxygen in the metal experimented with.

The specific gravity of metallic niobium at 15·5° is 7·06 as a mean of two well-agreeing determinations made with half a gramme of substance.

Niobium Trichloride, $NbCl_3$.—When the vapour of niobium pentachloride is passed through a heated glass tube it is slowly decomposed, a black deposit of trichloride being formed on the sides of the tube. Niobium trichloride is generally obtained as a black crystalline crust which possesses an almost metallic lustre, and closely resembles in appearance that of a film of sublimed iodine. It is sometimes deposited in long needle-shaped crystals which exhibit a dichroic lustre. The trichloride is non-volatile, it is not deliquescent, nor is it decomposed by water or ammonia, but when brought into contact with dilute nitric acid it is at once converted into niobic and hydrochloric acids. Heated in the air it emits dense white fumes.

For the purpose of analysis the trichloride, from several different preparations, was, in some cases, decomposed by nitric acid directly, and in others first fused with sodium carbonate and the fused mass treated with nitric acid.

	No. I.	No. II.	No. III.
Substance taken	0·2781	0·4406	0·5344
Nb_2O obtained	0·1930	0·3000	0·3611
AgCl	0·5681	0·9333	1·1218

	Calculated.	No. I.	No. II.	No. III.
Niobium, Nb ..	46·88	46·68	47·76	47·42
Chlorine, Cl_3 ..	53·12	52·53	52·40	51·93
	100·00	99·21	100·16	99·35

When the vapour of niobium oxychloride is passed over red-hot charcoal in an atmosphere of carbon dioxide no change occurs, and the pentachloride is obtained when the carbon dioxide is replaced by chlorine.

A remarkable reaction occurs when niobium trichloride is heated in a current of carbon dioxide; this gas is decomposed, a white sublimate, consisting of oxychloride, is obtained, and the corresponding quantity of carbon monoxide is formed.

That this is the case was ascertained by analysing the oxychloride and by collecting the gas over caustic potash and measuring the volume of insoluble gas which came over. This gas was shown to burn with a blue flame, and the quantity was found in two experiments to correspond closely with the theoretical amount. The following is the composition of the oxychloride thus prepared:—

	Found.
Niobium	43·48
Chlorine	47·03
Oxygen	9·49
	100·00

A decomposition of carbon dioxide by a metallic chloride has hitherto not been observed. Phosphorus trichloride absorbs free oxygen on distillation in the air, with formation of oxychloride, but it does not decompose carbon dioxide.

"*On the Retention of Saline Impurities by Hydrated Ferric Oxide*," by Mr. CHARLES FREDERICK CROSS, Dalton Scholar in the Owens College. Communicated by Prof. H. E. ROSCOE, F.R.S.

It is a fact well-known to all chemists that ferric oxide, when precipitated in the form of hydrate from solutions which contain either organic matter or the fixed alkalies, carries down a certain quantity of these substances in adhesive union.

That this adhesive action is exerted upon *saline* bodies in solution, although an obvious inference, I have found nowhere stated to be the case. The importance of the analytical bearings of such a property, if it do exist, led me to undertake a quantitative investigation of the matter, the results of which I proceed briefly to detail.

I. Two grms. fine iron wire were dissolved in HCl, the solution oxidised with HNO_3, the excess of acid driven off by evaporation, distilled water added, and the volume of this solution of ferric chloride made up to about 50 c.c.

The weight of this solution was found to be 56·0955 grms. 1 grm. therefore contains 0·0356 grm. Fe as Fe_2Cl_6.

To verify this calculation: 2·529 grms. solution were precipitated by ammonia, and the iron estimated as oxide in the usual way.

	Found.	Calculated.	Difference.
Fe	0·0896	0·0901	0·0005

A series of determinations was then made in which the oxide was precipitated by ammonia in presence of sodium chloride, which was selected as a typical saline compound. The results are tabulated below:—

	Weight of Solution taken.	Weight of Fe contained.	Weight NaCl added.	Weight Fe from Fe_2O_3 obtained.	Error.
a.	2·556	0·0911	2·000	0·0938	0·0027
b.	2·574	0·0917	2·000	0·0940	0·0023
c.	2·579	0·0919	1·000	0·0945	0·0026
d.	2·542	0·0906	2·000	0·0952	0·0046
e.	2·480	0·0884	2·000	0·0941	0·0057
f.	2·587	0·0922	2·000	0·0994	0·0072

a. Wash-water 350 c.c. precipitated in *boiling* solution.
b. Wash-water 250 c.c. precipitated in *boiling* solution.
c. Wash-water 125 c.c. precipitated in *boiling* solution.
d. Wash-water 175 c.c. NaCl added after precipitation.
e. Wash-water 175 c.c. precipitated in *cold* solution.
f. Wash-water 375 c.c. precipitated in *cold* solution.

In the above determinations no more than the ordinary precautions were adopted, *i.e.*, the precipitate was washed with boiling distilled water from 15 to 30 times until the washings no longer gave an alkaline reaction.

In some cases the precipitate of oxide was re-dissolved after weighing in HCl, and the iron precipitated as sulphide. The filtrate from the latter was evaporated and the residue ignited—in every case a considerable fixed residue of sodium chloride was obtained.

A similar series of determinations was then made with ferrous ammonium sulphate; weighed quantities were oxidised with nitric acid and ferric oxide precipitated by ammonia in presence of sodium chloride. The results obtained were identical with those already cited. In two of these determinations caustic potash was substituted for ammonia: the results obtained deserve mention:—

II.—

	Weight of $Fe(NH_4)_2 2SO_4 \cdot 6H_2O$.	Percentage Fe theoretical.	Weight of KOH & NaCl added. Grms.	Percentage Fe from Fe_2O_3 obtained.	Error per cent.
g.	0·706	14·28	5 KOH, 5 NaCl	17·93	3·65
h.	0·720	—	—	18·76	4·48

g. Wash-water = 950 c.c. precipitated in *boiling* solution.
h. Wash-water = 400 c.c. precipitated in *boiling* solution.

The precipitates were re-dissolved in concentrated HCl after weighing. They were observed to effervesce violently on treatment with the acid, and on evaporating the solu-

tion the alkaline chloride crystallised out in considerable quantities.

I instance these as indicating the extent of adhesion existing between ferric oxide and the fixed alkalies, and the futility of the practice, which I believe is not unusual, of weighing a precipitate of the oxide from which alumina has been removed by means of potash, without previously re-dissolving and again precipitating.

Determinations were then made in which special precautions were taken with the view of ascertaining the limit of the error due to the retention of alkaline salt. A weighed quantity of pure iron was taken for each experiment. The results are appended:—

III.—

	Weight Fe taken.	NaCl added.	Weight Fe calculated from Fe_2O_3 obtained.	Error.
k.	0·1669	0·000	0·1666	−0·0003
l.	0·2088	1·000	0·2096	+0·0008
m.	0·1485	1·000	0·1498	+0·0013

k, *l*, *m*. Washed persistently with boiling water till washing absolutely free from chlorine.

The impurity present in the precipitate in *m* was isolated in the manner described above and weighed. It was found = 0·0023 grm. Multiplying this by 0·7, the fraction expressing the ratio $Fe_2 : Fe_2O_3$, we obtain the number 0·0016, which it will be seen is in close agreement with the error obtained (calculated as Fe).

In the following experiment pure iron was brought into solution as Fe_2Cl_6, and precipitated by ammonia alone. The precipitate was thoroughly washed till the washings were absolutely free from chlorine, and transferred, together with the filter-paper, to a retort containing a solution of caustic soda, which had been freed from ammonia by prolonged boiling. The retort was connected with a condenser, the contents of the retort boiled, and the distillate "Nesslerised" in successive portions. The result is appended:—

	Weight Fe taken.	NH_3 estimated in distillate.	Calculated as NH_4Cl.
n.	0·2265	0·00054	0·0017

n. 500 c.c. boiling distilled water employed in washing the precipitate of oxide.

Determinations were then made in which other alkaline salts were substituted for sodium chloride:—

IV.—

	Weight Fe taken.	Salt added. Grm.	Weight Fe found.	Error.
p.	0·1600	LiCl. 0·25	0·1603	0·0003
q.	0·2165	Na_2SO_4	0·2191	0·0026
r.	0·2060	KNO_3	0·2097	0·0037
s.	0·1820	KNO_3	0·1866	0·0046

p. The isolated impurity was examined with the spectroscope, which showed strong Li line.

q. Washings gave H_2SO_4 reaction after all HCl removed, 500 c.c. employed.

r. Wash-water = 325 c.c. precipitate in boiling solution.

s. Wash-water = 650 c.c. precipitated in cold solution.

Having thus sufficiently investigated the adhesive action of ferric hydrate upon salts of the alkalies in solution, determinations were made in which salts of the alkaline earths were substituted for the former. For these experiments it was necessary to employ ammonia free from carbonate, which was prepared by agitating the ordinary solution with lime in a closed flask and filtering just prior to use. Care was taken to add the reagent in but very slight excess. The following results were obtained:—

V.—

	Weight Fe taken.	Salt added.	Weight Fe found.	Error.
t.	0·173	$CaCl_2$	0·1786	0·0056
v.	0·192	$CaCl_2$	0·2052	0·0132

t. Precipitated in boiling solution. Wash-water = 330 c.c.

v. Precipitated in cold solution. Wash-water = 650 c.c.

Similar results were obtained in presence of barium chloride. I may mention that by employing an ordinary laboratory solution of ammonia the error on 0·152 grm. Fe (precipitated in *hot* solution) amounted to 0·0072, and on 0·2313 (precipitated in *cold* solution) to 0·0196 grm. These results were confirmed by isolating the impurities and determining the calcium by precipitation as oxalate. The precipitates effervesced considerably on treatment with the acid.

The above experiments suffice to indicate the magnitude of the obvious error which attends the common practice of separating iron and similar oxides from the alkaline earths by precipitation with excess of alkali.

Since iron is very frequently separated from other metals in the form of the basic acetate, the purity of this compound, *i.e.*, of the oxide which results from the washing and ignition of the same, was made the subject of the following determinations:—

VI.—

	Weight Fe taken.	Salt added.	Weight Fe found.	Error.
w.	0·1995	NaCl	0·2007	0·0012
x.	0·2106	NaCl	0·2122	0·0016
y.	0·1800	$CaCl_2$	0·1825	0·0025
z.	0·1987	$CaCl_2$	0·2000	0·0013

w and *x*. In all cases solution Fe_2Cl_6 nearly neutralised with $(NH_4)_2CO_3$ and precipitated by $NaC_2H_3O_2$ in excess.

y. Only a trace of Ca could be detected in the isolated impurity.

Here as before it is seen that alkaline salt is retained by the iron oxide, but the separation of the latter from the alkaline earths is practically complete.

The general conclusions to be drawn from the above results are:—

(1.) That ferric oxide, when precipitated in presence of salts of the fixed alkalies, removes a certain quantity of the latter from solutions, this quantity being within certain limits independent of the amount of alkaline salt present in solution, but varying with the temperature of the solution at the time of precipitation, being much greater in the case of cold than of hot solutions (I., IV.).

(2.) That the error due to the retention of alkaline salt may, by persistent washing with boiling water, be reduced to a minimum, but not completely eliminated (III.).

(3.) That the error is very much greater when the oxide is precipitated by excess of alkali in presence of salts of the alkaline earths; but that the latter may be effectually separated from iron by precipitating this metal in the form of the basic acetate.

(4.) That ferrous sulphide does not exert this adhesive action upon salts in solution, and is therefore, where the circumstances of the analysis permit, the best form in which to separate iron from the other metals which accompany it.

In conclusion, I would briefly call attention to the researches of Reichardt and Blumtritt* upon the adhesive action of iron oxide upon gases, as affording indirect evidence in favour of the conclusions at which I have arrived from a consideration of the results of my investigation.

The former chemist found that 100 grms. of ferric hydrate, recently prepared by precipitation with ammonia from a solution of ferric chloride, yielded under suitable conditions, 375·54 c.c. of a gaseous mixture (O, N, and CO_2); that the same weight of hydrate previously washed with hot water yielded 250·82 c.c.; and that 100 grms. of the oxide, after gentle ignition, were found to retain 40 c.c. of gas. These results, together with the composition of the gaseous mixtures in each case, is set forth in the following table:—

* *Journ. Prakt. Chem.*, ii., 440 to 467 (1866).

Weight of substance, 100 grms.

Condition of Oxide Experimented upon.	Vol. of gaseous mixture in c.c.	Ratio of vol. of substance in that of gas.	Percentage Composition of Gas by vol.			Wt. of CO_2 = *i.e.*, percentage.
By precipitating Fe_2Cl_6 with NH_4OH, and drying in the air	375·54	1 : 3·00	N. 26·29—	O. 3·85—	CO_2. 69·86	0·51
After washing with hot water	250·82	1 : 3·50	18·90—	0·91—	80·19	0·39
After gentle ignition ..	42·69	1 : 0·58	65·32—	10·54—	24·14	0·02

These facts not only explain the fact of the retention of the fixed alkalies and alkaline earths in the form of carbonates, which I have stated to be the case, but compel the inference, apart from experimental verification, that the adhesive action of ferric hydrate upon saline bodies in solution would be equally characteristic.

ROYAL SOCIETY OF NEW SOUTH WALES.

Section B.—Chemistry and Geology.

A monthly meeting of this Section was held on the evening of Friday, November 16th, Prof. Liversidge in the chair.

Prof. Liversidge exhibited some interesting specimens of the siliceous and other deposits from some of the hot springs in New Zealand. He stated that he was not prepared with any paper descriptive of them, or of the geology of the localities whence they were obtained, for such would take up much more time than he could at present devote to the matter; and, moreover, such a paper would perhaps be more or less superfluous, after the many able descriptions of these springs which had been already published by various observers. He would only trouble them with a few remarks upon certain of the specimens, and would invite their attention to the series of photographs placed on the table in lieu of any description of the places.

Amongst the specimens were some samples of siliceous sinter, from a spring opposite the hotel at Ohaiawai, on the road between the Bay of Islands and Hokianga, on the west coast; also of cinnabar, from the mercurial springs near to the same place. Prof. Liversidge mentioned that he was much struck by the general similarity between the "volcanic" phenomena at Ohaiawai and those presented by the burning coal seam at Mount Wingen, the so-called "burning mountain," near to Scone —the chief differences being that the phenomena at the latter place are confined to a more limited area, and that water is absent; hence there are no hot springs or pools of warm water at Mount Wingen, as there would be if the jets of steam and heated vapour had to make their upward passage through water.

The escaping gases at both places possess very much the same general character, and deposit similar sublimates of sulphur and certain volatile salts around the vents.

At the hot mercurial springs near Ohaiawai the mercury occurs both in the native state and in the form of cinnabar. Some of the cinnabar is apparently of recent deposition, since it was observed in one place to uniformly and completely fill certain small cracks and crevices existing in the shaly rock; but the greater part of it is evidently mechanically brought to the spot by the small stream which runs down to the lake. The presence of an extensive deposit of coal, shale, or pyrites undergoing a smothered combustion or oxidation, would be quite sufficient to account for the phenomena observed at Ohaiawai and other hot springs in New Zealand,—even for the celebrated ones at Ohinemutu and at the Pink and White Terraces on the Lake Rotomahana.

Respecting the beautiful bright blue colour of the water in the basins on the Pink and White Terraces at Rotomahana, a blue so extraordinarily beautiful that travellers are unable to find words to express their admiration for it, Prof. Liversidge explained that the blue colour was due to the reflection of the light from the innumerable minute particles of silica suspended in the water—just as the pale sky-blue colour of a mixture of milk and water is caused by the reflection of the light from the minute fat globules suspended in it. He was also inclined to attribute the equally beautiful blue colour of the lower layers of steam floating over the surface of the boiling waters to a similar cause, for he had but little doubt that the escaping steam bears minute particles of silica with it in its upward course.

The colour of the steam does not appear to be due to a reflection of the colour of the water below it, any more than the colour of the water in the basin is due to a reflection of the sky.

The beautiful opalescent blue of the water in the basin is very different in appearance from the clear, but equally magnificent, purple-blue of one of *ngwahas*, or boiling springs, near Ohinemutu. This latter blue water is remarkably transparent, and one can see down through it to very great depths, but the Terrace water is rendered too turbid by the silica in suspension for the eye to penetrate far down into it.

Part of the silica brought up by the water is thrown down as a soft pulverulent deposit at the bottom of the basins, while another portion is more slowly precipitated as a hard and smooth stony material, known as siliceous sinter or geysirite, and it is of this that the terraces and basins are built up; so rapidly is this deposited that leaves and twigs become quickly invested, and it is stated that even dead birds become coated with it before the animal matter has time to decay and fall to pieces.

The pink colour of the Pink terrace is apparently due to the entanglement by the asperities on the stalactitic faces of the terraces of small quantities of red clay brought down by the water.

A specimen of recently-formed iron pyrites, which had been taken from a mass now forming upon some dead twigs in one of the hot springs (Jack Loffley's, the Taupo guide) at Lake Taupo, was also shown. On examination, this mass of mixed newly-formed pyrites and dead vegetable matter was found to contain traces of gold.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

November, 1877.

L. Pfaundler, "*Smallest Absolute Number of Vibrations necessary to yield a Tone.*" Experiments on a siren with two openings show that two isolated acoustic vibrations are capable of producing a tone, which alone is not sensible, but on repetition can be heard.

E. Secher, "*Specific Heat of Mixtures of Methyl-Alcohol and Water.*" Some of these mixtures are found to possess a greater specific heat than water or dilute ethyl-alcohol, and to be surpassed in this respect by hydrogen only, amongst known bodies.

F. v. Höhnel, *Investigations on Cork, Xylophilin, and Coniferin.* The suberin which forms the chief constituent of cork is found to be a well-defined substance, capable of building up membranes, insoluble in alcohol, characterised by reactions with potassium, nitro-acid, and chromic acid, and containing 74 per cent C and 10 per cent H, with no N. The violet colouration often yielded by woody tissues in contact with HCl results from the presence of xylophin, a colourless substance, soluble in water and alcohol, which is found in about 60 per cent of the various woods. Coniferin seems to be present in small quantities as a constant companion of lignin, and its intense blue-green reaction with phenol and HCl can be used as a test for lignin.

CORRESPONDENCE.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

SIR,—Observing that, at the eleventh hour, some of the professional chemists of Britain are awakening to a sense of the injury that is being attempted to be done to them under the guise of "organisation," I ask you to spare me a corner for a short explanation of my action in the matter, which I regret to say has been misrepresented by certain interested parties.

I have never for a moment objected to, and indeed would cordially support, any fair attempt at universal organisation; but when I ascertained that a certain number of the friends of the promoters of the present scheme had met together by invitation, and decided to form themselves into a limited company to choose whom they should, or should not, declare competent, by electing them members of their Institute, I felt so strongly the danger of such a proceeding to the mass of professional chemists throughout the country that I forthwith entered at the Board of Trade a protest against the registration. I will not here give a copy of that protest, with all its tedious legal phraseology, but simply say that in it I urged two points:—

1. That, looking to the rights of existing chemists in practice, no such organisation should be permitted, unless it started on the distinct basis of at once admitting every practising chemist in Britain, at the date of its formation. In support of this view I quoted the existing legal organisations of the medical and pharmaceutical professions, both of which were distinctly started on that fair and honest footing, and I pointed out the injury likely to result if A, an analyst in some place who knew a promoter, could get himself invited, and then quietly deposit his black ball against his opponent B, in the same town.
2. That no body of men should be granted any registration unless they were themselves really and truly practising professional chemists. Under this head I pointed out that the self-elected nucleus contained many persons—such as purely Government servants, pharmacists, and *dilettanti*—who did not come under the category of real professional chemists, earning a living by their business, and that it would be grossly unjust that such men should sit in judgment to select competent persons to be honoured by their new qualification.

To this the Board of Trade, after a long consideration, replied that they had no legal power to refuse registration, but that if I and the others who held my views chose to form a company they would register us on the same footing.

Having thus explained the grounds of my (as I venture to submit) most reasonable opposition to the present scheme, I would earnestly ask the professional chemists of England to pause and consider before they consent to humble themselves by submitting to the vote of the present directors of this limited company. If, on consideration, they think as I do, the thing will simply die a natural death, and those whose vanity has been tickled by being invited as truly competent men, and who have therefore accepted blindfolded, will find that all they get in return is simply the loss of their entrance-money and a future contribution towards the winding-up of the company in Chancery.

If the present company wish a real success, let them adopt the only just and legal method of organisation, as above sketched, and give up the secret elections and marked favouritism which has hitherto distinguished them.—I am, &c.,

JOHN MUTER.

South London Central Laboratory, Kennington Cross,
January 14, 1878.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

SIR,—In your issue of the 4th (CHEM. NEWS, vol. xxxvii., p. 8), a letter relating to the above Institute appeared, signed "Well-wisher," and dated December 26th, with most of which I cordially agree. There are, however, some inaccuracies in it, or rather expressions which may tend to produce erroneous impressions, as for instance "that the whole organisation has been arranged by a council of chemists in London." It is true that the *meetings* were held in London; but of the forty-nine chemists composing the original committee sixteen were country members, residing in various parts of the United Kingdom—for it was one of the chief objects of the promoters to render this organisation committee as representative as possible, not only in special departments of chemistry, but also with reference to all the great centres of manufacturing industry and scientific education.

Although I cannot ask for space to give, as your correspondent suggests, "very full information" in reference to the Institute, seeing that the Memorandum and Articles of Association, containing an account of the qualifications required of candidates for admission as Fellows or Associates, and Rules for the regulation of the Society, form a pamphlet of some twenty-four closely-printed pages; yet there are one or two points in connection with the Institute which may interest your readers, and which can be very briefly stated.

1, The officers and other members of the present Council, who were naturally selected almost entirely from the members of the organisation committee, are as follows:—

President—Dr. Frankland.

Vice-Presidents—Prof. F. A. Abel, Dr. A. Crum-Brown, Prof. R. Galloway, Dr. W. Odling, Dr. R. A. Smith, and Dr. A. Voelcker.

Treasurer—Dr. C. R. A. Wright.

Other Members of Council—Dr. Attfield, Messrs. J. Bell, D. Campbell, M. Carteighe, W. Crookes, and G. E. Davis, Dr. W. De la Rue, Prof. Dittmar, Dr. Dupré, Mr. R. J. Friswell, Dr. Gladstone, Messrs. G. Gore, W. N. Hartley, D. Herman, D. Howard, and C. T. Kingzett, Prof. Marreco, Mr. F. A. Manning, Dr. E. J. Mills, Messrs. E. Neison and J. Pattinson, Dr. Redwood, Prof. J. Emerson Reynolds, Dr. T. Stevenson, Mr. R. R. Tatlock, Prof. R. V. Tuson, and Mr. T. Way.

2. The objects for which the Association is established are—To promote and encourage a thorough study of Chemistry and all branches of Science allied thereto, in their application to the Arts, to Agriculture, to Public Health, and to Technical Industry, and to adopt such measures as may be necessary for the advancement of the profession of Chemistry, and particularly for the maintenance of the profession of the consulting and analytical chemist on a sound and satisfactory basis.

Information as to the constitution of the Institute, powers of council, qualifications for admission, fees, &c., may be obtained from the Secretary, as stated in the Advertisement, which appeared in the CHEMICAL NEWS of December 28th and in subsequent numbers, so that if "Well-wisher" desires to be admitted to the Institute, and will send me his name and address, I shall be very happy to forward him a copy of the articles and any other information in my power.—I am, &c.

CHARLES E. GROVES,
Secretary to the Institute.

Somerset House Terrace, W.C.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—As Solicitor to the Institute of Chemistry you will allow me to reply to your correspondent "Nemo me impune lacessit" (Chem. News, vol. xxxvii., p. 19).

Although the Institute has been registered under a special provision of the Companies Act, 1867, inserted in that Act for the special purpose of meeting a case like that of the Institute, it is not the fact—as suggested by your correspondent—that the Institute has been registered as a "limited liability" company, in the sense in which that expression is generally used.

By availing themselves of this special provision of the Act of Parliament the founders of the Institute have secured the advantages of legal incorporation, whereby the Institute secures the right of perpetual existence, a constitution elastic and capable of being adapted to the proved and ever-changing requirements of the body of 'professional chemists," and due provision against liability on the part of its individual members.

The objects for which the Institute was established, as stated in the Memorandum of Association and sanctioned by the Board of Trade, after reference had been made by the Board to the Privy Council, the Pharmaceutical Society, and Dr. Greenhow, are as follows:—

"(A.) To promote and encourage a thorough study of Chemistry, and all branches of Science allied thereto, in their application to the Arts, to Agriculture, to Public Health, and to Technical Industry.

"(B.) To adopt such measures as may be necessary for the advancement of the profession of Chemistry, and particularly for the maintenance of the profession of the consulting and analytical chemist, on a sound and satisfactory basis.

"(C.) The doing of all such other lawful things as are incidental or conducive to the attainment of the above objects."

And the condition on which the Board of Trade granted a license for the registration of the Institute under the provision of the Act to which reference has already been made, and which is set out in the Memorandum of Association, requires the whole income and property of the Institute, whencesoever derived, to be applied solely towards the promotion of the above objects, and prohibits any portion thereof being paid or transferred directly or indirectly by way of dividend or bonus, or otherwise howsoever, by way of profit to any persons who are or have been members of the Institute; but there is a saving clause which permits payments, when made in good faith, of remuneration to any professors, examiners, lecturers, tutors, secretary, or other officers or servants of the Institute, or other person, in return for any services actually rendered, or goods or other property sold, to the Institute.

The violation of this condition renders unlimited the liability of every member of the council; and the liability of every member of the Institute who has received any such dividend, bonus, or profit, is in such case likewise unlimited; but in every other case (in the event of the Institute being wound up) the liability of each person who is then a member of the Institute (or who was a member at any time within twelve months previously to the winding up) to pay the debts and liabilities of the Institute is limited to a sum not to exceed £5.

The extent of a member's liability is this sum of £5, and this sum has only to be paid in the case of the Institute being dissolved and its assets proving insufficient to pay its debts. Having regard to the character of the men forming the Council and the number of persons who are joining the Institute, there is a prospect of the most abundant success, and no danger of a failure of the scheme. No person need therefore fear the liability resting upon him when he becomes a member of the Institute.—I am, &c.,

J. Pettengill.

32, Walbrook, London,
January 16, 1878.

BUTTER ANALYSIS.

To the Editor of the Chemical News.

Sir,—Whether the name "Stopcock Flask" or "Separating Funnel" be applied to the apparatus I figured is of little moment: as, however, it is made by letting a stopcock into the bottom of a flask, I prefer the name that I gave it.

I am quite aware that "the idea of separating fatty acids in a flask is not new," as it was proposed by Dr. Muter long ago, but, having had more than a year's experience of the method I described, I have found that it is simple and expeditious. I preferred waiting until I had satisfied myself that by means of it all the difficulties in the estimation of the insoluble fatty acids had been got rid of.

It will be found that the solution of the cake of acids in ether, and the separation of all water in the way described, much facilitates the drying, and I think that the "stopcock flask" will be found to offer considerable practical advantages for this part of the process, while the transference of the soap from the saponifying flask to the stopcock flask—if conducted in the manner suggested—is at most a trifling disadvantage.

I leave it to those who have to make butter analyses to find out whether they prefer this plan or the one described by Mr. Wynter Blyth.—I am, &c.,

W. H. Corfield, M.A., M.D. (Oxon).

University College,
January 16, 1878.

AMMONIA IN FILTERED WATER.

To the Editor of the Chemical News.

Sir,—I have read the two letters (Chem. News, vol. xxxvii. p. 19), replying to my communication of the 4th instant, and I wish now to state that the water *before* filtration was found to be practically free from nitrates or nitrites, and I ought to have stated this before. Had these salts been present my wonder would have ceased.—I am, &c.,

Geo. Jones.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 48, December, 1877.

Report presented by M. Lamy on behalf of the Committee of Chemical Arts on a Memoir entitled "Manufacture of Sugar Candy," by M. Flourens.—The manufacture of sugar candy is said to be of considerable importance at Nantes, in the north of France, and in Belgium. M. Flourens has drawn up tables showing the amount of saccharine matter in saturated solutions from 0° to 100° with the corresponding degrees of the areometer and densimeter, the density and the areometric degree of the same solutions at the temperature of 15°, and the boiling-point of these solutions at different degrees of concentration.

Studies on Nitro-glycerin and Dynamite.—A. Brull (Continuation).—A prolonged treatise quite incapable of useful abstraction.

Origin of Natural Amber and on the Characters by which it is distinguished from Artificial Amber.—M. Rehoux.—The author mentions two principal localities where amber occurs; Sicily, whence the chief supply was obtained in antiquity, and the coasts of the Baltic, where it appears to consist chiefly of the fossilised resin of an extinct conifer, *Pinus succinus*. The production of amber in 1874 amounted to 1874 kilos. Amber may be distinguished from artificial amber and from every substance having any physical analogy with it, especially copal, by the following characters:—Copal is yellow, more or less deep, but always unicolorous; it has on its surface some yellow points like crystallised sulphur. Amber, on the contrary, has always one end of a different shade from the other. If a sample is rubbed for a few seconds upon the palm of the hand near the little finger, if it exhales a strong aromatic odour, it is amber, for neither copal nor artificial amber has any odour. On prolonged exposure to the air amber sometimes loses its essential oil and its characteristic aspect. If copal is scraped with the blade of a knife a fine dust is given off, which rises in the air. If amber is scraped the raspings fall downwards. If amber is gently heated at the flame of a candle it may be bent, whilst artificial amber and copal are inflexible under the same circumstances. Natural amber resists pressure with the nails, whilst factitious amber and copal are indented. Copal melts at 100°, and when liquefied preserves its yellow colour. Amber does not melt below 400°; it blackens and gives off a very distinct odour of sulphuretted hydrogen. Its specific gravity is 1·09 to 1·11, that of copal being 1·04, and that of artificial amber 1·05. Yellow amber, according to Schrötter, is composed of:

Carbon	78·82
Hydrogen	10·23
Oxygen	10·90
	99·95

—*Annales de Chimie.*

Journal für Praktische Chemie.
No. 16, 1877.

Plato-nitrites and Diplato-nitrites.—L. F. Nilson.—The author describes with great exactness and completeness nearly the entire series of metallic salts with the so-called plato-nitrosylic acid, $H_2.4NO_2.Pt$ (see CHEMICAL NEWS, xxxiv., 270), formerly considered as acid platinous nitrite. The crystalline properties of these compounds are surpassed by but few series of salts. With a number of bases, such as Fe_2O_3,HgO, &c., diplato-nitrites are formed of the general formula $Ag_2.4NO_2.Pt_2O$.

The Warm Springs of Asmannshausen.—R. Fresenius.—The water from these springs is found to contain 1000 parts 0·0278 parts of bicarbonate of lithium, a percentage which places it foremost in the list of alkaline springs containing appreciable amounts of the salts of this rare metal.

Quantitative Spectral Analysis, and a New Spectro-photometer.—G. Hüfner.—The author has prepared a somewhat complicated apparatus for the application of the spectroscope to quantitative analysis, based on the most elaborate physical and physiological observations. The essential principle is the use of a Nicol's prism, through which passes a ray of light which has traversed the medium to be analysed. The arrangement allows of the comparison of this ray with one passing through a normal solution, and by revolving the prism the light of the brighter ray is reduced to the same degree as that of its companion. The angle described by the revolving prism gives, then, the difference in the two liquids, which are placed otherwise under the same conditions as to quantity, source of light, &c. Experiments showed a probable error of 0·83 per cent in the various determinations.

Separation of Media Free from Oxygen.—F. W. Gunning.—Pasteur and other chemists claim that they have observed the ability of certain kinds of bacteria to exist and manifest activity by a complete absence of oxygen. The question has been raised as to the completeness of the exclusion of oxygen, and the author first shows that the absence of a phosphoresce when phosphorus is introduced into a gas does not prove the absence of oxygen. This is done by the use of a much more sensitive reagent, namely, the precipitate obtained on combining ferrocyanide of potassium and a ferrous salt, which when pure is perfectly white, and becomes blue only in contact with oxygen. The experiments showed, likewise, that it was impossible to free an apparatus from oxygen simply by absorption with P. The use of the new reagent has also made manifest that it is impossible to prepare atmospheres of H, CO_2, or even H_2S and SO_2, entirely free from O by the customary methods. The best reagent for the absorption of O is ascertained to be a mixture of a solution of ferrous salt with an excess of HNaO or with grape-sugar. The precipitate from the ferrocyanide remains perfectly white in an apparatus containing this solution.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 14, December 6, 1877.

Aroma of Butter.—Many butters, especially those made in winter, are devoid of aroma. To remedy this evil a Silesian farmer keeps suspended in his churn, when empty and closed, a calico bag containing white and yellow melilot, queen of the meadow (*Asperula odorata*), and other odoriferous meadow herbs. When the cream is to be churned four smaller bags of the same materials are fastened to the arms of the churn. In this manner butters possessing the aroma of mountain growths may be produced.

No. 15, December 12, 1877.

Telluric Theory of Cholera.—MM. Pettenkofer and Decaisne conclude that cholera occurs upon all geological formations, but its development and propagation are affected by the physical aggregation of the soil, its permeability for water and for air, and the variable quantity of water which it contains. The disease prefers, not merely certain quarters in the locality, but also certain regions in the country, avoiding others. On board ship as a rule cholera does not spread. The upholders of the telluric theory have always admitted a specific infectious matter, a cholera germ, which is propagated by human communication, but not by the free air at great distances.

No. 16, December 20, 1877.

M. Gramme, the inventor of the well known continuous-current magneto-electric machine, has been nominated a chevalier of the Legion of Honour.

M. Trouvé has succeeded in passing the sound of a repeater when it strikes the hour through a resistance equal to 3000 kilometres of distance.

The entire stock of one of the most important dealers in wines, specially intended for pharmaceutical purposes, has been seized as being entirely compounded of spirit of wine and sugar, flavoured with different herbs.

A bee-keeper, writing to the *Journal du Loiret*, foretells a mild winter, since the bees have not closed the entrances to the hives with wax, as he has observed them do when a hard winter is at hand.

Under the heading "New Application of Dynamite," we are told that it has been employed in the United States felling trees. Where we should expect a description of the process follow these words:—"A voltaic

battery is taken and the two poles are connected with a platinum wire heated to whiteness. The wire is laid against the tree and contact is made. The wire passes across the wood and burns it rapidly. Thus a tree which the most skilful woodman could not fell in three or four hours is cut in two in a quarter of an hour." Where is the dynamite?

M. Mure, of Bourg, St. Andeol, asserts that the Jablochkoff battery, in which charcoal takes the place of zinc, is not novel.

Myopism and Civilisation.—Dr. Loring finds that shortsightedness is greatly on the increase. On 2265 scholars in the public schools of New York, sound vision was found in 87 per cent of those under seven years of age, but between the ages of seven and twenty-one only in 61 per cent. Among the causes he ranks, not merely excessive study, but a sedentary life, insufficient nutrition, bad air, and general absence of hygienic precautions. Microscopic work affects the eyes less at a tolerably advanced age than when taken up in youth.

MISCELLANEOUS.

University of Durham.—James Murphy, B.A., M.D., has been appointed to the Chair of Botany at the University of Durham College of Medicine, at Newcastle-on-Tyne.

The Use of Maté in Europe.—According to the *Allgemeine Chemiker Zeitung* "Paraguay tea" has been introduced into Austria, where it is strongly recommended by Prof. Kletzinsky as a dietetically happy combination of caffein and tannin, and as the most salutary of all beverages of this class. Our contemporary continues—"Far be it from us to contradict Prof. Kletzinsky, although when we exert our memory we find the name Kletzinsky everywhere when it is required to set a proprietary article, such as a hair-dye, a pomade, &c., upon its feet; and thus the name is apt to make us shudder." Might we not almost say—

"mutato nomine de . . .
Fabula narratur?"

Disinfecting Properties of Cellulosic Substances Carbonised with Concentrated Sulphuric Acid.—F. Garcin.—Wood, paper, rags, &c., if plunged for a few moments into concentrated sulphuric acid, are transformed into a black substance, which is not pure carbon, but retains hydrogen, and approaches the humic products, and possesses a remarkable absorbing and disinfecting power. —*Comptes Rendus.*

MEETINGS FOR THE WEEK.

MONDAY, 21st.—Medical, 8.
—— London Institution, 5.
TUESDAY 22nd.—Civil Engineers, 8.
—— Anthropological, 8.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
WEDNESDAY, 23rd.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 24th.—London Institution, 7.
—— Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
FRIDAY, 25th.—Quekett Club, 8.
—— Royal Institution, 8. Weekly Meeting. "On William Harvey," Prof. Huxley, 9.
SATURDAY, 26th.—Royal Institution, 3. "Carthage and the Carthaginians," R. Bosworth Smith, M.A.

TO CORRESPONDENTS.

C. H. Parkin.—Fownes's "Chemistry," Bloxam's "Laboratory Teaching," Roscoe's "Chemistry."

Erratum.—In Vol. xxxvi., p. 281, the article on the "Sale of Food and Drugs Act for Germany" should have been acknowledged from advance sheets of *The Analyst.*

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ROYAL INSTITUTION OF GREAT BRITAIN
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ARRANGEMENTS FOR NEXT WEEK.

HOUR, THREE O'CLOCK.

Professor ALFRED H. GARROD, M.A., F.R.S.—Twelve Lectures on the Protoplasmic Theory of Life, and its Bearing on Physiology; beginning on Tuesday next, Jan. 22.

JAMES DEWAR, Esq., M.A., F.R.S.—Twelve Lectures on the Chemistry of the Organic World: on Thursday next, Jan. 24.

R. BOSWORTH SMITH, Esq., M.A.—Seven Lectures on Carthage and the Carthaginians; on Saturday next, Jan. 26.

Subscription to all the Courses in the Season, Two Guineas; to a Single Course, according to length, One Guinea, or Half-a-Guinea.

Tickets now issued daily.

The Friday Evening Meetings will begin on January 25th, at 8 p.m., when Professor Huxley will give a Discourse at 9 p.m., on William Harvey.—Professor Tyndall will probably give the Discourse on March 22.

Borough of NEWPORT, MONMOUTHSHIRE.

SALE OF FOOD AND DRUGS ACT, 1875.

This Corporation is desirous of receiving Applications from Gentlemen competent to act as PUBLIC ANALYST for this Borough.

Applications, stating Terms and accompanied by Testimonials, are to be sent to my Office, endorsed "Public Analyst," not later than Monday, the 28th instant, and the Appointment will be made subject to the approval of the Local Government Board.

THOS. WOOLLETT,
January 14, 1878. *Town Clerk.*

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THE CHEMICAL NEWS.

Vol. XXXVII. No. 948.

ON DYER'S CHEMICALS.

By J. MARZELL.

In consequence of the very low prices to which an overproduction has made the tar-products sink to, it might be of interest to many a manufacturer to learn something of the way of working up the crude products to articles of a better market-value.

The far greater portion of the tar-products being used for the artificial dyes, it is the manufacturing of the intermediate articles required in that branch which is of main interest; and it is a strange fact that the so-called dyer's chemicals, having a good market in England itself, are nearly all imported from the Continent, whilst a great part of the English crude products go abroad.

Let us, then, consider the various ways of working them up to their derivatives.

A. *Benzol and its Derivatives.*
- Pure benzol.
- Resorcin.
- Methyl-aniline.
- Dinitro-benzol.
- β-Phenylen-diamin.
- Diphenylamin, and its alcoholic derivatives.

B. *Phenol (Carbolic Acid).*
- Manipulation.
- Purifying.
- Picric Acid.

C. *Naphthalin.*
- Manipulation.
- Purifying.
- Naphthylamin.
- Naphthol.
- Phthalic acid.
- Benzoic acid.

D. *Anthracen.*
- Manipulation.
- Purifying. {Washing. Subliming.
- Anthraquinon.

A. Benzol Derivatives.

Pure Benzol.

The base and starting-point for all these articles is a good pure benzol, and it is imperative—so as not to spoil all the work from beginning—that its extreme boiling-points do not vary more than 2° to 3° C.; a benzol going over between 82° to 84° C. (middle temperature) being sufficient.

Referring to the manufacture on a large scale of such a pure benzol, it rests upon fractional distillation; that is to say, on separating the different bodies according to their boiling-points, by carefully working with the refluxing condenser.

Following these principles Mansfield had already constructed an apparatus in 1847, but this was more fitted for the laboratory than for the industry.

In 1860 E. Kopp recommended the use of the column-apparatus employed in rectifying spirit, and in 1863 A. Coupier introduced the same into the practice, with only a few modifications.

The apparatus itself and its working are thoroughly described in Muspratt's new edition, and therefore elaborate detail is not necessary.

Notwithstanding its simplicity the apparatus requires very careful observation as to the heights of the thermometers, pressure of steam, &c.

The refrigerating liquid (reflux condenser) generally consists of a solution of chloride of calcium, which, in case the obtaining of xylol and cumol is wanted, must be replaced by paraffin or a saturated solution of nitrate of ammonia, not boiling below 164° C. To bring it to that temperature it must be subjected to a pressure of steam of 5 to 6 atmospheres.

The following are some data connected with the process:—

To obtain—	Temperature of the Reflux Bath.	Pressure of Steam in the Still.
Benzol	60° to 70° C.	2½ atmospheres.
Toluol	100 ,, 105 ,,	3½ ,,
Xylol	130 ,, 135 ,,	4½ ,,
Cumol	160 ,, 163 ,,	5 to 6 ,,

Referring to the proportions for chloride of calcium baths, the following practical notes may be useful:—

Solution of	50	$CaCl_2$ in 100	H_2O boils at	112° C.
,,	100	,, 100	,,	,, 128 ,,
,,	200	,, 100	,,	,, 158 ,,
,,	325	,, 100	,,	,, 180 ,,

According to M. Coupier, the yield of a benzol (100 litres) boiling between 80° and 150° C. would be as follows:—

	Litres.	Boiling at—
Mixture (benzol and lower boiling products	6	62° to 80° C.
Benzol	44	80 ,, 82 ,,
Mixture (benzol and toluol).. ..	6	82 ,, 110 ,,
Toluol	17	110 ,, 112 ,,
Mixture (toluol and xylol)	5	112 ,, 137 ,,
Xylol	9	137 ,, 140 ,,
Mixture (xylol and higher boiling products)	5	140 ,, 148 ,,
?	8	148 ,, 150 ,,
	100	

These numbers can be represented graphically by the accompanying diagram.

Naturally a good market product (say 90 per cent benzol) has to be taken to start with.

Resorcin, $C_6H_4(OH)_2$.

When the discovery* and industrious realisation† of eosin rendered the manufacturing of resorcin necessary, the old method—dry distillation of Fernambuk extract, &c.,—had to be discarded, and, according to the constitution of the body, benzol and phenol were taken for crude materials.

The resorcin is a dioxy-benzol or mono-xyphenol, the two hydroxyls assuming the meta (1·3) place in the benzol ring.

Oppenheim and Vogt‡ treated benzol with chlorine and iodine, and converted the so-obtained chlor-benzol into mono-chlor-benzol-sulpho acid, the soda-salt of which they melted, observing some precautions, with twice the quantity of caustic soda,—

$$C_6H_4\begin{Bmatrix}Cl\\SO_3\end{Bmatrix}Na+\begin{Bmatrix}NaOH\\NaOH\end{Bmatrix}=NaCl+Na_2SO_3+$$
$$+C_6H_4\begin{Bmatrix}OH & 1.\\OH & 3.\end{Bmatrix}$$

They got a resorcin of b. p. 104° C.

According to Faust‖ there is comparatively much resorcin formed by melting chlor-phenol,—

$$\left(C_6H_4\begin{Bmatrix}OH\\Cl\end{Bmatrix}\right),$$

* Bayer and Caro, *Berichte der Deutsch. Chem. Gesell.*, viii., 147. *Moniteur Scientifique* (3), v., 395. A. W. Hofmann, *Berichte der Deutsch. Chem. Gesell.*, viii., 62. *Moniteur Scientifique* (3), v., 291.

† Bindschädler and Busch, *Mon. Scient.* (3), v., 974. M. L. Durand, *Mon. Scient.* (3), vii., 696.

‡ *Zeitschrift für Chemie*, 1868, p. 722.

‖ *Berichte der Deutsch. Chem. Gesell.*, 1873, p. 1022

of b. p. 218° C., with caustic potassa,—

$$C_6H_4\left\{\begin{matrix}OH\\Cl\end{matrix}\right\}+KOH=KCl+C_6H_4\left\{\begin{matrix}OH & 1.\\OH & 3.\end{matrix}\right.$$

whilst Petersen and Bähr-Bredari* only got hydrochinon (the isomer with the hydroxyls in 1·4) in that way.

C. Wurster and E. Nölting† converted brom-nitro-benzol,—

$$\left(C_6H_4\left\{\begin{matrix}Br\\NO_2\end{matrix}\right.\right),$$

of b. p. 56° C. (obtained from brom-nitro-amido-benzol, Wurster‡) by reduction with tin and hydrochloric acid into a brom-anilin,—

$$\left(C_6H_4\left\{\begin{matrix}Br\\NH_2\end{matrix}\right.\right),$$

of b. p. 241·5° C. By means of the diazo-derivative they get a brom-phenol,—

$$\left(C_6H_4\left\{\begin{matrix}OH\\Br\end{matrix}\right.\right),$$

of 227° to 229° C. b. p., which, by melting with caustic soda, yields a resorcin of b. p. 102° C.

R. Fittig and E. Mager|| obtained large quantities of resorcin by melting para-brom-phenol with caustic soda and a little water, at a low temperature.

According to E. Nölting and Wrzesinski,§ para-iod-phenol—yielding hydrochinon at 165° C.—is converted into resorcin at a higher temperature when melted with caustic soda.

Egli¶ produces benzol-disulpho acid by treating sulphuric acid, heated up to 240° C., with vapours of benzol, and gets resorcin by melting the soda-salt of the same with caustic soda,—

$$C_6H_4\left\{\begin{matrix}SO_3Na\\SO_3Na\end{matrix}\right.+\left\{\begin{matrix}NaOH\\NaOH\end{matrix}\right.=2SO_3Na_2+C_6H_4\left\{\begin{matrix}OH.\\OH.\end{matrix}\right.$$

For the manufacture on a large scale only two ways seem to be of interest:—

1. Diluting halogen-derivatives of benzol—either chlorine or bromine—in fuming sulphuric acid, and baking the soda-salt of the resulting chlor-benzol-sulpho acid with caustic soda.
2. Benzol-disulpho acid, obtained by treating sulphuric acid at a certain temperature with benzol vapours, is converted into its soda-salt, and baked with caustic soda.

A very intelligible way is the following:—Heating up a solution of phenol in concentrated sulphuric acid, the ortho-phenol-sulpho acid first formed will be converted into the meta modification, the soda-salt of which ought to give resorcin by baking with caustic soda.* But the researches of Kekulé† and Zincke‡ in that direction have not been successful.

Manufacturing Process.

Concentrated sulphuric acid, 1·813 sp. gr. (4 parts of weight) is treated with benzol vapours (1 part of weight) at a certain temperature—according to M. L. Durand at 240° C.

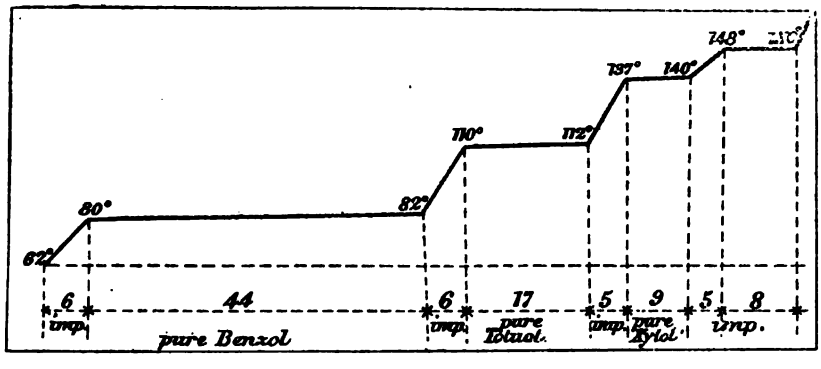
The apparatus containing the sulphuric acid is fitted, besides the inlet-pipe, &c., with an outlet ending in a condenser, which collects the unabsorbed benzol. The condensed product is pumped back into the benzol-still.

The operation finished, the whole is put into ten times its volume of water, and neutralised with lime.

The quantity of lime necessary for neutralising can be calculated from the sulphuric acid used. In a wooden vessel, fitted either with a wooden agitator or a steam-injector, the lime is converted into a thin milk of lime, and then the melt added. The agitator is moving all the time.

The free sulphuric acid forms insoluble sulphate of lime, which precipitates, whilst the lime-salt of the benzol-disulpho acid remains in solution.

By pumping through filter-presses the sulphate of lime



is separated; but the mass containing a quantity o sulpho-salt ought to be washed carefully, which is effected with little difficulty if the presses are provided with a washing apparatus.

As to the filter-presses themselves, it is best to take such as have iron plates, and are proved for high pressure.

The liquor, containing the lime-salt of the benzol-bisulpho acid,—

$$(C_6H_4<\begin{matrix}SO_3\\SO_3\end{matrix}>Ca),$$

is heated up, and treated with carbonate of soda till a sample does not show any precipitate on addition of more Na_2CO_3.

$$C_6H_4\left\{\begin{matrix}SO_3\\SO_3\end{matrix}\right\}Ca+Na_2CO_3=C_6H_4\left\{\begin{matrix}SO_3Na\\SO_3Na\end{matrix}\right\}+CaCO_3.$$

As evaporating pans open vessels can be used, even with a steam jacket or a system of steam-pipes laid on the bottom.

The resulting precipitate of carbonate of lime is separated by filter-pressing, and the filtrate evaporated down to dryness, the resulting residue, of a light hue, representing the sodium-salt,—

$$C_6H_4\left\{\begin{matrix}SO_3Na.\\SO_3Na.\end{matrix}\right.$$

Mixed with five times its weight of caustic soda, the

* *Zeitschrift für Chemie*, 1870, p. 246.
† *Berichte der Deutsch. Chem. Gesell.*, 1874, p. 904.
‡ *Ibid.*, 1873, p. 1542.
|| *Ibid.*, 1874, p. 1177.
§ *Ibid.*, 1875, p. 820.
¶ *Ibid.*, viii., 871. *Moniteur Scientifique* (3), v., 974.

* *Wagner's Jahresberichte*, 1874.
† *Belg. Academie*, Aug. 3, 1867.
‡ *Journal für Praktische Chemie*, viii., p. 43.

mass is baked in iron vessels, fitted with an agitator, and heated up by means of an oil-bath. The temperature should not rise above 250° C., and the operation will not last longer than 24 to 36 hours.*

The melt, taken out, is diluted in water, and sulphuric or muriatic acid added in a fine stream. The so-obtained liquid contains the resorcin in a free state, and sulphate of soda or NaCl.

By letting the cold fluid stand quietly a great part of the sulphate of soda is allowed to crystallise out, and can be separated by filtering. Brought into a mixing apparatus and treated with ether, the latter dissolves the resorcin. The ether, swimming on the surface, is drawn off, and the resorcin will be obtained as residue by evaporating the ether in a still. It is a yellow, transparent mass, ready for working up.

It is remarkable that, by re-crystallisation from boiling benzol, the resorcin can be obtained in quite colourless crystals.

The manufacturing of this body is of a very recent date, and many improvements are still to be made. So, *e.g.*, the heating up of the sulphuric acid to 240° C. is as needless as noxious, the destruction of a part of the benzol taking place. The evaporating to dryness of the sulpho-salt is very disagreeable in working on a large scale—wasting time, space, and steam; an evasion of the extraction with ether would at all events be of great influence on the price of the article. Tests of the state of the melt would have to be made upon non-attacked sodium-salt of the disulpho-benzolic acid, and the possible intermediate product of phenol-sulpho-acid,—

$$\left(C_6H_4 \begin{cases} OH \\ SO_3Na \end{cases} \right).$$

The identity in so many points with the manufacture of artificial alizarin at all events realises many experiences made in that older branch.

Properties and Reactions of Resorcin.

It is very soluble in water, alcohol, and ether, crystallising from very concentrated solutions in prisms belonging to the trimetric system. It melts at 104° C. and boils at 201° C., subliming at a lower temperature, and distilling almost without residue. Its aqueous solution is coloured black-violet by ferric chloride, violet by chloride of lime, and reduces silver nitrate to an alkaline cupric solution, throwing down cuprous oxide in the latter case.

(To be continued).

ON THE PRESENCE OF HYDROGEN PEROXIDE IN THE ATMOSPHERE.

By SERGIUS KERN, M.E., St. Petersburg.

In Moscow, in 1874, Schöne made several experiments on the occurrence of H_2O_2 in rain, snow, dew, and hoar-frost (*Centr. Blatt. für Agrikult. Chemie*, June, 1875). His researches were so interesting that, during the summer time of the last two years, some researches on this question were commenced by the author in St. Petersburg—properly in a village situated about 12 versts higher than the town, on the River Neva.

The present paper refers only to the results obtained in 1877, as the experiments of this year were conducted in a more strict manner.

A. Houzeau is of the opinion that there is a connection between the quantity of H_2O_2 present in the atmosphere and the place where the experiments are executed (*Comptes Rendus*, vol. lxx.). The author, indeed, found a difference between the occurrence of H_2O_2 in rains of St. Petersburg and Moscow. But as the experiments of the author were made in 1877, and Schöne's in 1874, it is rather difficult to give a decided opinion on the remarks of Houzeau. In this case there is a want of further investigations.

The quantity of H_2O_2 in rains was detected by the method proposed by Schöne. A neutral solution of H_2O_2 in water, where the quantity of hydrogen peroxide was examined by titration with mineral chameleon, was used, in order to prepare ten solutions, which contained in 1 litre of water 0·1, 0·2, 0·3, 0·4, 0·5, 0·6, 0·7, 0·8, 0·9, 1·0 m.grms. of hydrogen peroxide. From every such solution 25 c.c. were placed into test-tubes of equal size, and 0·5 c.c. of potassium iodide solution (5 per cent of KI, 95 per cent of H_2O) was next poured into every test-tube, with the addition of 0·5 c.c. of a feeble aqueous solution of starch.

After standing quietly for about ten hours the solutions receive a bluish tint of different colourations.

These ten normal solutions were used in calculating the quantity of H_2O_2 in rain-water, 25 c.c. of which were mixed with the same quantity of potassium iodide and starch solutions as mentioned above. The colouration received was next compared with the normal solutions.

The normal solutions were found to be good for a fortnight.

The following table shows the quantity of hydrogen peroxide found in rains during four months:—

Milligrammes in One Litre of Rain.

	Direction of Wind.							
	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
June ..	0·4	0·3	—	0·3	0·8	0·4	0·5	0·1
July ..	0·3	0·1	0·2	0·2	1·4	0·5	0·4	—
August..	0·3	—	0·1	0·1	0·3	0·3	—	0·1
September	0·1	—	—	0·5	0·7	0·2	0·4	—

From this table a graphical disposition of the occurrence of H_2O_2 in rains during the four months may be arranged according to the winds.

The polar winds bring rain poorer in H_2O_2 than the equatorial winds.

Such experiments could be of some use in meteorology if regular observations were commenced in certain points of the earth. Secondly, the occurrence of H_2O_2 in air may be very important for vegetal and animal existence.

TEST FOR ELATERIN.

By DAVID LINDO.

The active principle in elaterium affords a very beautiful reaction with carbolic acid, and concentrated sulphuric acid. The test may be applied as follows:—

Place a few crystals of elaterin in a small porcelain capsule, and add one or two drops of liquefied crystals of carbolic acid (Calvert's No. 1 liquefied by moisture).

The elaterin dissolves in the carbolic without production of colour; but if two or three drops of concentrated sulphuric acid are allowed to flow into the mixture, an intense and beautiful carmine colour is developed, changing at first to orange, and after some time to scarlet. Alkalies discharge the colour. I have not been able to obtain a reaction resembling this with any of the alkaloids and carbolic acid, nor with any other substance tried.*

If liquefied crystals of carbolic acid are not at hand the solid crystals can be used. After adding them to the elaterin, add a drop of chloroform or alcohol before applying the sulphuric acid. The addition of sulphuric acid alone to elaterin gives rise to no characteristic colour.

* M. L. Durand, *Moniteur Scientifique* (3), vi., 696.

* If a nitrate in the *dry* state is treated in the same way with carbolic and sulphuric acids, a deep green colour is developed, which changes to red on the addition of a little water.

The elaterin cakes together, dissolves slowly, and imparts a yellow colour to the acid. If the carbolic is now added the reaction is obtained very imperfectly. The reagents should therefore be added in the order stated above.

The test can be applied direct to some samples of the elaterium of commerce (dried sediment of the juice) if they are reduced to fine powder.

Other samples may require the powder to be agitated with chloroform and the solution filtered. A few drops of the filtrate evaporated to dryness by blowing on the surface will afford a residue for testing.

Falmouth, Jamaica,
December 6, 1877.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 17, 1878.

Professor ODLING, Vice-President, in the Chair.

AFTER the confirmation of the minutes of the previous meeting, the reading of presents to the Library, &c., the following certificates were read for the first time:—W. Hudson, G. S. Johnson, T. Lichtenstein, W. B. Lowe, and L. T. Wright.

The CHAIRMAN then announced that a ballot for the election of Fellows would take place at the next meeting of the Society (Feb. 7).

The first paper was entitled "*On the Luminosity of Benzol when Burnt with Non-luminous Combustible Gases*," by E. FRANKLAND and L. T. THORNE. It was pointed out by Dr. Frankland in 1852 (*Memoirs Manchester Lit. and Phil. Soc.*, 2nd Series, x., 71) that hydrogen, carbonic oxide, and marsh gas practically contribute nothing to the luminosity of coal gas, and that the only constituents of value were benzol, ethylene, propylene, butylene, and acetylene. The authors have endeavoured to determine the luminosity of benzol individually, and propose in future papers to make similar experiments on the other illuminating constituents of coal gas. Many attempts were made to burn benzol with a smokeless flame, and several lamps were constructed by Mr. Silber, but all the experiments yielded unsatisfactory results, and the authors had to limit their experiments to the determination of the luminosity of benzol vapour after dilution with hydrogen, carbonic oxide, and marsh gas. These three gases were severally prepared in the usual way, and were passed through a brass cylinder, 6½ inches long, 3 inches internal diameter, packed with sponge saturated with pure benzol, the whole being kept at a constant temperature by immersion in water. The quantity of benzol in the gas was determined by absorption with sulphuric acid. The authors obtained the following numbers:—

1 cub. foot of benzol vapour burnt with hydrogen gave for one hour the light of ..	69·71 candles.
Ditto with carbonic oxide	73·38 „
Ditto with marsh gas (1st series)	92·45 „
Ditto with marsh gas (2nd series)	93·94 „

at the standard temperature and pressure. Hence, 1 lb. avoirdupois of benzol gives, when burnt with hydrogen, the light yielded by 5·793 lbs. of spermaceti; with carbonic oxide, 6·100; with marsh gas (1st series), 7·682; with marsh gas (2nd series), 7·803; or, in other words, a given weight of benzol produces 5·3 per cent more light when it is diluted with carbonic oxide, and between 32·6 and 34·7 per cent more light when diluted with marsh gas than when diffused in hydrogen. The authors point out that this difference is probably due at all events in part to the different pyrometric thermal effects of the gaseous mixtures. A fish-tail burner was used throughout the experiments.

In reply to the CHAIRMAN, Dr. FRANKLAND stated that this increase in the illuminating power of benzol when mixed with marsh gas was not opposed to his former statement, that marsh gas did not contribute materially to the illuminating power of coal gas, because in coal gas the principal hydrocarbons were ethylene and members of that series, which would not raise the temperature to any considerable extent when burnt with marsh gas as compared with the effect produced by benzol vapour and marsh gas.

After the thanks of the Society had been given to the authors, Dr. GILBERT, Vice-President, took the Chair.

The next paper was read by Mr. PERKIN, "*On the Action of Reducing Agents on Potassium Permanganate*," by F. JONES. Hydrogen in neutral solutions decomposes permanganate according to the following equation: $2KMnO_4+8H=Mn_2O_3+2KHO+3H_2O$; the reaction is hastened by raising the temperature. In solutions rendered acid by sulphuric acid hydrogen produces a similar decomposition. In alkaline solutions a similar action takes place, but much more slowly, a manganate being first formed. Ammonia produces the decomposition—

$$8KMnO_4+8NH_3=$$
$$=4Mn_2O_3+KNO_3+KNO_2+6KHO+9H_2O+6N$$

Phosphine when passed through a series of flasks containing solution of potassium permanganate forms sesquioxide of manganese, phosphorous and phosphoric acids, $6KMnO_4+4PH_3=$

$$=3Mn_2O_3+2K_2HPO_3+2KH_2PO_3+3H_2O$$

and $2KMnO_4+PH_3=Mn_2O_3+K_2HPO_4+H_2O$. Arsine produces a similar reaction,—

$$2KMnO_4+AsH_3=Mn_2O_3+K_2HAsO_4+H_2O.$$

The reaction with stibine is—

$$2KMnO_4+SbH_3=Mn_2O_3+K_2HSbO_4+H_2O.$$

The first action of oxalic acid on potassium permanganate results in the formation of manganese and potassium oxalates, water, and carbonic acid. A further addition of permanganate precipitates manganese sesquioxide, carbonic acid and oxygen being evolved, and potassium carbonate formed. In the presence of sulphuric acid oxygen is given off. Oxygen is also evolved with carbonic acid, when sulphuric acid acts on manganese dioxide in presence of an oxalate. When strong solutions of permanganate and manganese chloride are mixed, sesquioxide of manganese separates out, whilst bubbles, consisting of chlorine and oxygen are evolved. By mixing dilute solutions oxygen, but no chlorine, is evolved. Solutions of ferrous and manganese sulphates similarly evolve oxygen when mixed with solutions of potassium permanganate.

Mr. HOWARD remarked that in the Exhibition at Paris, 1867, a compound was exhibited which was said to be permanganate of ammonium; it exploded eventually with some violence. It was curious that such a compound could have been formed and sent to the exhibition when, according to the reaction in the above paper, ammonia decomposes permanganate soon after the substances are mixed.

The next paper was read by Mr. SPENCER PICKERING, "*On the Action of Sulphuric Acid on Copper.*" According to the author there are only two primary reactions. The first is represented by the equation—

$$Cu+2H_2SO_4=CuSO_4+SO_2+2H_2O,$$

the second, $5Cu+4H_2SO_4=Cu_2S+3CuSO_4+4H_2O$. Other products which may be formed are due to the subsequent decomposition of the sub-sulphide by sulphuric acid. Pure electrotype-foil, 0·15 m.m. thick, was used, 0·3 grm. being acted on by 16·3 c.c. strong sulphuric acid (sp. gr. 1·843) for thirty minutes. The action commences at 19°, rapidly increasing as the temperature rises. But little gas is evolved until 130° is reached. No gas, such

as oxygen and hydrogen, insoluble in water, is given off, nor any sulphuretted hydrogen liberated during the reaction. The sub-sulphide formed seems to be deposited on the metal itself in a compact layer: it is not oxidised by exposure to air, or by drying in a steam-bath at 100° C. Care was taken that some copper was always left undissolved at the end of the experiment. The author gives in a table the results of many experiments made at different temperatures. At 19° C. 0·00015 per cent Cu dissolved in thirty seconds; at 100° C., 0·052 per cent; at 150°, 1·15 per cent; at 220°, 70·57 per cent; at 270°, nearly 100 per cent in a few seconds. In two experiments the proportion of copper converted into sulphide to that converted into sulphate was found to be 2 : 2·914 and 2 : 2·964. At high temperatures but little sulphide is formed. The action of sulphuric acid on protosulphide is represented by the equation—

$$2CuS + 4H_2SO_4 = S_2 + 2CuSO_4 + 4H_2O + 2SO_2.$$

The decomposition of the subsulphide by the equation—

$$Cu_2S + 2H_2SO_4 = CuS + CuSO_4 + 2H_2O + SO_2.$$

The author thinks that the formation of the copper sulphide is due to the direct union of the copper with the sulphur in the acid, which opinion is supported by quantitative experiments and various theoretical considerations. The quantities of sulphuric acid actually used in the experiments, and the amount of the sulphurous acid evolved were determined, and found to agree with those required by the above equations. In some experiments a small sublimate of sulphur was observed round the neck of the flask in which the copper had been dissolved. This is probably due to the tendency of free sulphur to creep up the sides of the containing vessel. The effect of an electric current was tried. When the copper was rendered electro-positive it dissolved more rapidly and more sulphide was formed. When it was electro-negative more sulphate was produced and less sulphide. In some experiments the coating of sulphide protected the copper from the action of the acid to a notable extent. If the copper used be impure it dissolves more rapidly, and two sulphides are formed, owing to the rapid formation of subsulphide and its subsequent decomposition by the acid. The author suggests that the increased action of the acid on impure copper may be due to some sort of catalytic action of the impurities, analogous perhaps to the solution of alloys of platinum and silver in nitric acid. The action of dilute acids was also investigated. In conclusion, the author gives a *resumé* of the explanations which have been offered from time to time of the action of sulphuric acid on copper by previous experimenters, and criticises their results.

The next communication was "*On the Analysis of Sugar*," by G. JONES. The author proposes to estimate sucrose volumetrically by adding a 0·1 per cent solution to a decinormal solution of permanganate acidulated with sulphuric acid until the dirty brown hydrated peroxide of manganese, which is at first formed, is reduced and dissolved. The solution, contained in a porcelain dish, is boiled after each addition of the saccharine liquid. No analyses are given, but the author states that in every case he obtained results which fully justify him in drawing attention to the process. The colouring matters in sugar do not seem to affect the value of the estimations.

Mr. WARINGTON drew attention to the fact that this use of permanganate must be limited to cases in which the sugar was tolerably pure, and that it would be useless for determinations of the sugar present, *e.g.*, in the juice of the beet-root, &c.

The last paper was "*On the Decomposition-Products of Quinine*, by W. RAMSAY and J. DOBBIE. 5 grms. of quinine were gently heated with 50 grms. of permanganate in solution. After complete reduction the alkaline liquid was filtered, neutralised with nitric acid, and precipitated with nitrate of lead. The precipitate was decomposed by sulphuretted hydrogen, the new acid converted into a silver salt, and the latter decomposed by sulphuretted hydrogen. The filtrate, evaporated *in vacuo*, furnished needle-like crystals of a new acid, which proved to be dicarbo-pyridenic acid, identical with that obtained by Dewar from picoline. It gave 9·6 per cent water, 3·16 per cent H, and 44·56 per cent C. Dicarbo-pyridenic acid contains 9·83 per cent water, 3·00 H, and 50·30 per cent C. The new acid contains nitrogen, melts at 251° to 252°, gives a red colour with ferrous sulphate, and a characteristic odour on heating. The silver salt gave 56·21 per cent Ag, and behaves like mercury sulphocyanide. By titration the potassium salt contains 32·5 per cent K, the soda salt 21·76 per cent Na. The salts of dicarbo-pyridenic acid contain respectively 56·69 per cent Ag, 32·15 per cent K, and 21·80 per cent Na. Besides the acid, some quantity of a red deposit was obtained. The yield of this substance was diminished by effecting the reaction at 100°, whilst the yield of acid was increased. By oxidising Marchand's quinetin with permanganate the authors obtained an acid identical with the one above described.

The Society then adjourned to February 7, when the following papers will be read:—"Notes on the Tannins," by Dr. Paul and Mr. Kingzett; "On a Method for the Determination of Boiling-points," by H. C. Jones; "On the Alkaloids of the Aconite Family (Part II., the Alkaloids of *Aconitum ferox*)," by Dr. Wright and Mr. Luff; "An Enquiry into the Action of the Copper-Zinc Couple on Alkaline Oxy-salts," by Dr. Gladstone and Mr. Tribe; "On the Estimation of Phosphorus in Iron and Steel," by E. Riley.

PHYSICAL SOCIETY.

January 19, 1878.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidates were elected members of the Society:—J. Angell, Lieut. G. S. Clark, R.E., T. F. Iselin, M.A., J. W. Russell, M.A.

Mr. W. H. PREECE read a paper "*On Some Physical Points Connected with the Telephone.*" This instrument may be employed both as a source of a new kind of current and as the detector of currents which are incapable of influencing the galvanometer. It shows that the form and duration of Faraday's magneto-electric currents are dependent on the rate and duration of motion of the lines of force producing them, and that the currents produced by the alteration of a magnetic field vary in strength with the rate of alteration of that field; and further, that the infinitely small and possibly only molecular movement of the iron plate is sufficient to occasion the requisite motion of the lines of force. He pointed out that the telephone explodes the notion that iron takes time to be magnetised and de-magnetised. Mr. R. S. Brough has calculated that the strongest current employed in a telephone is $\frac{1}{10000000}$th of the CGS unit. Mr. Preece explained that the dimensions of the coil and plate depend on the strength of the magnet, but the former should always consist of fine wire and be made as flat and thin as possible. The adjustment of the position of the magnet (as near as possible to the plate without touching) is easily effected by sounding a vowel sound *ah* or *o* clearly and loudly; a jar is heard when they are too near together. After briefly enumerating the attempts which have been made to improve the instrument he mentioned the various purposes to which it can be applied. In addition to being useful in the lecture room in conjunction with several well-known forms of apparatus, it forms an excellent detector in a Wheatstone bridge for testing short lengths of wire, and condensers can be adjusted by its means with great accuracy. M. Niaudet has shown, by employing a doubly wound coil, that it can be used to detect currents from doubtful sources of electricity, and it is excellent as

a means of testing leaky insulators. Among the facts already proved by the telephone may be mentioned the existence of currents due to induction in wires contiguous to wires carrying currents, even when these are near each other for only a short distance. Mr. Preece finds that if the telephone wire be enclosed in a conducting sheath which is in connection with the earth all effects of electric induction are avoided; and, further, if the sheath be of iron, magnetic induction also is avoided, and the telephone acts perfectly. A great number of experiments on the use of the instrument on telegraphic lines were then described, from which it appears that conversation can be carried on through 100 miles of submarine cable, or 200 miles of a single wire without difficulty with the instrument as now constructed. The leakage occurring on pole-lines is fatal to its use in wet weather for distances beyond five miles. An interesting series of telephones was exhibited, and by means of one of very large dimensions Mr. Preece showed that the current produced by pressing the centre of the plate sensibly affects a Thomson galvanometer, and that the motion of the needle ceases in a remarkably instantaneous manner, as soon as the pressure is removed, a necessary condition, in order that the receiving-plate should accurately reproduce the motions of the sending-plate.

In the discussion which followed,

Mr. R. SABINE suggested that the failure of all attempts at improving the instrument by increasing its dimensions might be due to the *damping* action of the permanent magnet on the plate, the strain on it being proportional to the size of magnet, and rendering it less sensitive to the sonorous waves.

Mr. COFFIN pointed out how interesting it would be if, instead of employing a receiving instrument, the currents could be communicated directly to the auditory nerves.

Prof. ADAMS explained the relation subsisting between the character of the vibrations of the disk and the character of the electric currents to which they give rise.

Dr. LODGE described a simple form of apparatus for determining the thermal conductivity of rare substances, such as crystals, which cannot be obtained in slabs or rods. It consists of two small tin cans with a copper arm about 8 inches long projecting horizontally from each, the external ends being clean and flat. They are placed in a straight line with the crystal between them, and held together by a slight horizontal pressure. Holes are drilled in the copper rods for thermometers, and the curves of temperature being given by these, that for the intermediate crystal can be at once calculated.

CORRESPONDENCE.

AMMONIA IN FILTERED WATER.

To the Editor of the Chemical News.

SIR,—Mr. Slater's statement that no chemist would condemn a water because of the excessive amount of free ammonia found under certain conditions, emboldens one to ask if unwittingly many chemists do not do so?

One of the most important items to be considered in reporting upon the quality of a water is the geological nature of the strata, and this information is rarely asked for. Spongy iron produces large quantities of ammonia in water passed over it, but it must also be considered that *natural* water from ferruginous strata are under the same influences: the presence of large quantities of ammonia in water from the London Clay and from the Greensands is thus generally occasioned. The "Sixth Report of the Royal Rivers Commission" thoroughly deals with the geological question, and it will be observed that the analyses of water from all strata containing much iron resemble the analyses of water passed over spongy iron, in containing much ammonia and little nitrates.

In November, 1876, I was engaged on the question of a filter, to filter large quantities of water, especially with a view to the removal of nitrates and nitrites. The water was passed, at a rate of 3 litres per hour, over 21 ounces of spongy iron. The experiments were far from complete, and have not since been thoroughly entered upon from want of time. Another well-known filtering medium was absorbed at the same time.

Expressed in parts per 100,000, the results obtained from the Lambeth Company's water and from an exceedingly bad water are—

	Lambeth Company.		Bad Water.	
	Unfiltered.	Filtered.	Unfiltered.	Filtered
Ammonia	0·001	0·075	0·010	1·000
Albumenoid ammonia	0·016	0·003	0·036	0·035
Organic carbon ..	0·289	0·040	0·406	0·200
Organic nitrogen	0·036	0·003	0·228	0·079
Nitrogen as nitrates	—	—	6·540	6·248
Total combined nitrogen	—	—	6·776	7·150

Now it will be observed in this instance, as also in those of waters which have been passed over the spongy iron at a rapid rate, and from which the ferric hydrate has not been removed, that the total combined nitrogen is less before filtration, and consequently again must have taken place during filtration: below I will further allude to this. The comparative experiments with another filtering medium tend to show—That a large elimination of organic nitrogen takes place when water is passed over a spongy iron, while the carbon is not reduced in a corresponding ratio taken on the same water, and I am led to believe that oxidising filters especially remove organic carbon; reducing filters especially remove organic nitrogen; the action of spongy iron does not produce nitrites from nitrates, and their removal, even when the water is passed very slowly, is not more than 0·5 part of nitrogen per 100,000.

It is unfortunate that the "Sixth Report of the Royal Rivers Commission" does not mention the action of spongy iron on waters containing more than 0·25 part per 100,000 of nitrogen or nitrates.

The following experiment, which I have made previous to writing this letter, will suffice to show that the gain of nitrogen is not all due to reduced nitrates. A sample of ordinary recently-distilled water, containing ammonia 0·013 part per 100,000, was passed over the same spongy iron (which had been kept under water): it then contained ammonia 0·095 part per 100,000. The remainder was again passed over spongy iron, but no practical increase was found. Distillation, of course, was employed in the determination, and not more than ten minutes elapsed between the filtrations.

I hope, when I can obtain time, to again work upon the subject. It would be interesting to note if, by re-aëration, a further quantity of ammonia could have been obtained. The results show that an excess of 0·082 part per 100,000 of ammonia, equivalent to 0·067 of nitrogen, has been obtained.

In conclusion, I would add that these experiments were conducted in Messrs. Gillman and Spencer's laboratory.—I am, &c.,

JAMES DEATH.

Laboratory, St. George's Road, Southwark, S.E.,
January 16, 1878.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

SIR,—Now that the "Institute of Chemistry" has been the means of drawing prominent attention to the present unsatisfactory state of the chemical profession, and with

especial reference to the pertinent remarks about "the young English chemist" and the "careless place-man" in Mr. Wanklyn's letter in the CHEMICAL NEWS of the 11th inst., I would ask space for a few remarks on the whole subject of Principals and Assistants.

It seems to me that as long as chemical manufacturers and others requiring analyses accept the report of a Ph.D., D.C.L., or F.R.S., in preference to that of less distinguished chemists of presumably far greater experience than the *assistants* of the said Ph.D.'s, &c., so long will the status of analytical chemists be unsatisfactory. It seems perfectly monstrous that the analysis of an experienced man should be set aside by that of a mere boy acting as assistant to one of the leaders of the profession. I know positively that a certain eminent agricultural chemist never touches a beaker from one year's end to another, but merely comes to his laboratory to sign reports as a merchant signs cheques. I do not wish to doubt in the slightest degree the accuracy and conscientiousness of the assistant or assistants, but I am certainly of opinion that the report should be signed by the person who makes the analysis and countersigned by the principal. Indeed, I am astonished that the question has not arisen before, where criminal proceedings are taken, in cases of adulteration for instance. Probably it is because the magistrates have not been aware of the extent to which working by means of assistants is carried on: indeed, if on the bench myself I should be very unwilling to asperse the character of a defendant without asking the analyst if he could swear *personally* to the accuracy of the results. It is quite a different matter in the other professions, for a lawyer or civil engineer can glance over the work of his assistants, and so check it completely. But in chemistry everything depends on individual manipulation, and the principal has absolutely no check on the work, and has to depend entirely on the skill (and honour) of his assistants, who are in many cases boys of seventeen or eighteen, bound to him for three years, and without any remuneration. How can the work be done as accurately by these machines as by the principal?

A radical change is necessary. There are now some few chemists conscientious enough to refuse analyses because they are not practised in the special branch required. It ought not to be expected that one man should be thoroughly well up in the examination of every product. Another objectionable practice is that of reporting percentage to hundredths, or even thousandths in some few cases, whereas everyone knows that the tenths in an ordinary analysis differ (if a duplicate determination be made) as much as 2 or 3 or more. What falsehood there is in this system! He must be indeed a good analyst who can obtain results uniformly reliable to within $\frac{1}{100}$ of the amount of pure substance to be estimated.

To raise analytical chemistry to a dignity on a par with other professions our ranks must be recruited by well educated conscientious men thoroughly in love with their work, and not afraid to own their ignorance of a special branch of the science. We must have more principals and fewer assistants, by which means *machine work* will be abolished, a living interest displayed, and consequently accuracy greatly increased. In short, analytical chemists must act like other professional men, and as a gas engineer would refuse to undertake the setting-out of a water works, and as the legal profession is divided into solicitors, barristers, &c., so we ought to, and no doubt shall have, sections of chemists devoted specially to the examination of potable waters, nitre, phosphates, &c. In analytical chemistry, as in everything else, there is an irresistible tendency towards specialising.

Let us hope that the day is not far distant when those who require analyses and investigations will not be dazed by the "handles" after a name—or at least when they pay ten guineas to a D.C.L. for work which an ordinary analytical chemist would do for five—they will make sure that they really obtain the *services* of the former instead of the work of an assistant. If not, the *signature* of the Professor, &c., &c., seems rather dearly paid for, to my mind at all events.—I am, &c.,

ANALYTICAL CHEMIST.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

SIR,—The subject of the above Institute seems likely to be tolerably well ventilated in your columns, and I think there can be but one opinion as to the desirability of plentiful discussion. Perhaps you will kindly again allow me space for a few remarks. Mr. Groves's letter in your last issue is satisfactory as far as it goes, but it might have gone just a little further without any fear of becoming too lengthy. We now know the names of all the Officers and Council. It would be of great interest to know also the names of the original "organisation committee" which elected these gentlemen, and I cannot see any reason why these names should not also be published, thus assisting chemists to form a true and just estimate of the whole organisation. I believe the Institute has everything to gain and nothing to lose by giving full information, and taking the profession frankly into confidence. Mr. Groves might, I think, have said rather more as to the course of action which the Institute intends, or hopes, to pursue in furtherance of its objects, and as to how its influence and its funds will probably be brought to bear. But probably much could not be said as yet on this subject, and as Mr. Groves offers every information to everybody who cares to write for it, I think there is no further cause for complaint. As regards the legal liability of Fellows, Mr. Pettengill gives a sufficiently clear explanation in his letter; though what he means when he speaks of "the proved and ever-changing" requirements of chemists is probably known only to himself.

I may again state that my object in writing was sincerely that of a "Well Wisher," and I am very sorry to see the animosity which appears in some of the subsequent letters. But it seemed to me that those in charge of the Institute were committing a very grave mistake in going to work too quietly—indeed with an appearance of almost secrecy—and that thereby they would excite suspicion and ill-feeling, and lay themselves open to many unfavourable criticisms and insinuations.

For my own part I believe (and I trust the opinion may be shared by my fellow chemists generally) that some such organisation is necessary, and that if it were delayed till some scheme could be devised which should please all and offend none, most of us should have done with chemistry and all other earthly business long before anything could be effected. Even as it is we have waited a long time since the organisation was first proposed. Now, at last, something is offered to us, and I for one think that chemists cannot do better than cordially support it and make it a success. What it will eventually become will depend on the body of chemists who incorporate themselves with it; for, as I understand the matter, the present Council will take charge of the affairs of the Institute only for a time, and then an opportunity will be given for a complete re-arrangement and settlement of the whole organisation, guided by the experience gained in the meantime and by the collective wishes of the Fellows. Will it not be best—if we are *ever* to have a society to represent professional chemistry—to come forward and join this Institute, support it and the present governing body for a time, even though perfection may not be reached all at once, and eventually, after due trial and experience, consult and arrange for the future policy and government?

Dr. Muter makes a passionate appeal to us not to "humble ourselves" by submitting to the vote of the Council, or as he prefers to say, "the present directors of this limited company." I think most chemists will see the weakness of the grounds on which he rests this appeal. The difference between this proposed organisa-

tion and that of the medical profession is so great that I wonder Dr. Muter, or anyone else, can compare them. The medical profession is organised by law, and not for the protection of the doctors, but for that of the public. A man without the proper degrees may not practise medicine at all, and can be punished if he does. Of course it was necessary to admit everybody who was in practice when the law was passed, or those excluded may have been ruined. If any similar legal enactment were going to be made for the chemical profession it would then be necessary to admit every chemist who was living by his business at the time. But no such legal enactment is ever likely to take place for us; and how can anybody compare the organisation of a profession which is strictly controlled by law in order to prevent the public being slaughtered by unqualified persons with the organisation of a spontaneous union of chemists to attempt to better themselves and their profession? If every chemist were to be admitted at once, what would be the object of seeking fellowship? Is not one of the chief objects of the Institute to make some distinction between the "sheep and the goats," between those who have had a proper education for, and experience in, their profession and those who have neither the one nor the other? Are those of us who have trained ourselves by years of study, and have invested as much time and money in our profession as doctors, lawyers, &c., do in theirs, to go on for ever tacitly allowing ourselves to stand on a level with the crowd of unqualified humbugs, the "bottle-washers," the druggists who undertake to do analytical work in the intervals of making pills and lotions, and other interlopers too numerous to specify? I think the answer of chemists to these questions cannot be doubtful, and now that an attempt is being made to do something it is to be hoped that the attacks of Messrs. Muter, Wanklyn, and others will not deter chemists from supporting and assisting the movement, especially as these gentlemen do not offer us anything better. If we let them succeed in arresting the progress of this movement we may live many years and never see anything definite again attempted. Dr. Muter speaks of the "vanity" of certain people being "tickled" by the formation of the Institute. Perhaps it is a pity that more attention was not given to the tickling of vanity, as a good deal of opposition might so have been avoided!

Your correspondent, "Nemo me impune lacessit" (bless his long name!) encourages chemists by the assurance that their practice will not be interfered with by the Institute. Perhaps this is correct; but in any case I hope the bulk of our profession is made up of men who can rise a little above such a reflection as that of whether they are going directly and immediately to gain in purse or not by a movement like the present. Any chemist who can see no reason for a movement of organisation, or for giving his support, unless he can think he will at once thereby "put money in his purse" takes indeed a lowly view of things; and a profession made up of such men would deserve to remain in the state in which it now is, and into which it threatens to sink still deeper. I think better of my fellow chemists than this, and believe and hope that they will show that they think somewhat as I do. I believe that mistakes have been made in the starting of this Institute, and it was this that caused me to write first. But I believe that we shall see nothing better offered to us for many a day, and that the Council and Officers of the Institute are much removed above the mean and untrustworthy motives and conduct which have been imputed to them. I do not sign my name. It does not matter who I am, except that I am a trained chemist living by my profession, and that I have had no manner of connection with the organisation of the Institute. I simply appeal to my fellow chemists not to let themselves be led away from the chance we now have of doing something to fight the "bottle-washer" and his clan: and I again point out that when once a strong organisation is formed its policy and government can be altered if desired, and have such form given to them as shall seem best to the majority of the Fellows; so that even if there were for a time causes for dissatisfaction these could in due course be remedied. Surely this is better than standing idly waiting till perfection comes before us all at once!—I am, &c.,

WELL WISHER.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 26, December 24, 1877.

Rotatory Power of Meta-styrolen.—M. Berthelot.—Styrolen is a carbide of hydrogen, $C_{16}H_8$, a polymer of acetylen, and may be obtained by direct synthesis, either by condensing acetylen by heat, or by combining it directly with benzol, another polymer of acetylen. But the natural carbide is distinguished by the existence of a rotatory power. It turns polarised light to the left—

$$\left(\alpha_D = -3{\cdot}4^\circ\right).$$

The author has also shown that this property belongs to the perfectly pure carbide, free from oxygenated products and from all foreign matter.

Liquefaction of Oxygen.—M. Dumas, before making known to the Academy the important results obtained almost simultaneously by M. L. Cailletet and M. Raoul Pictet, on the liquefaction of oxygen, read the following extract from the works of Lavoisier ("Recueil des Mémoires de Chimie de Lavoisier; Œuvres de Lavoisier publiés par le Ministère de l'Instruction publique," t. ii., p. 804). This passage shows how the immortal creator of modern chemistry foresaw the facts which have been subsequently realised by Faraday and his successors:—"Let us reflect for a moment what would happen to the different substances composing the globe if its temperature were suddenly changed. Suppose, for instance, that the earth were transported at once into a much hotter region of the solar system,—into a region where the average temperature were much higher than that of boiling water,—very soon the water, and all other liquids capable of evaporation at temperatures bordering upon that of boiling water, and even certain metallic substances, would expand, and become transformed into aëriform fluids, which would then become part of the atmosphere. On the contrary, if the earth were suddenly placed in very cold regions,—for, instance, in those of Jupiter or Saturn,—the water which at present forms our rivers and seas, and probably the greater number of the liquids which we know, would be transformed into solid mountains. On this supposition the air, or at least a part of the aëriform substances which compose it, would doubtless cease to exist in the state of an invisible fluid for want of a sufficient degree of heat; it would return to the state of liquidity, and this change would produce new liquids of which we have no idea."

Condensation of Oxygen and of Carbonic Oxide.—L. Cailletet.—If we enclose pure oxygen or carbonic oxide in a tube of the form which I have describe dand placed in the compression apparatus which was set in action before the Academy, and if the gas is reduced to the temperature of −29° by means of sulphurous acid, and exposed to a temperature of about 300 atmospheres, these two gases remain in the gaseous state. But if they are suddenly released—which ought to produce, according to Poisson's formula, a further reduction of temperature of at least 200°—we see immediately a thick mist pro-

duced by the liquefaction, and perhaps by the solidification, of the oxygen or carbonic oxide. A similar phenomenon is observed on the escape of carbonic acid, and of the protoxide and binoxide of nitrogen, after being strongly compressed. This mist is produced in the case of oxygen even when the gas is at its ordinary temperature, provided that time is allowed for it to lose the heat which it has acquired by the mere fact of compression. This was demonstrated on December 16th, in the chemical laboratory of the superior Normal School, before a certain number of *savants* and professors, including some members of the Academy of Sciences. I had hoped to meet at Paris, in addition to the materials necessary for the production of intense cold (liquid protoxide of nitrogen or carbonic acid), a pump capable of being substituted for the compression-apparatus which I fitted up at Chatillon-sur-Seine. Unfortunately a pump well-arranged and suitable for such experiments was wanting in Paris, and I was obliged to bring from Chatillon-sur-Seine the refrigerants necessary for collecting the condensed matter on the walls of the tube. To decide if the oxygen and the carbonic oxide are in a liquid or in a solid state, there is merely required an optical experiment, more easy to imagine than to realise, on account of the form and the thickness of the tubes in which they are contained. Certain chemical experiments will also permit us to decide that the oxygen is not transformed into ozone in the act of compression. I reserve to myself the study of all these questions by means of apparatus which is being specially constructed. Under the same conditions of temperature and pressure pure hydrogen, released with the greatest rapidity, gives no trace of nebulous matter. Nitrogen only remains to be studied from this point of view, and its sparing solubility in water permits me to consider that it will prove very refractory.

Experiments of M. Raoul Pictet on the Liquefaction of Oxygen.—M. de Loynes.—The substance of this paper and of a communication from M. Pictet to M. Dumas, read at the Session of the Academy, December 24th, appeared in the CHEM. NEWS (vol. xxxvii., p. 1). M. Dumas also read the following letter, which had been addressed by M. Cailletet to M. H. Sainte-Claire Deville, on December 2nd, and which the latter had felt it his duty to deposit the next day, as a sealed paper, in the hands of the Perpetual Secretary:—

"I have to tell you first, and without losing a moment, that I have just this day liquefied oxygen and carbonic oxide. I am perhaps doing wrong to say liquefied, because at the temperature obtained by the evaporation of sulphurous acid, say −29°, and at a pressure of 300 atmospheres, I see no liquid, but a mist so dense that I infer the presence of a vapour very near its point of liquefaction. I write to-day to M. Deleuil to ask him for some protoxide of nitrogen, by means of which I shall be able, without doubt, to see oxygen and carbonic oxide flow.

"PS. I have just made an experiment which sets my mind greatly at ease. I subjected hydrogen to a pressure of 300 atmospheres, and after cooling down to −28° I released it suddenly. There was not a trace of mist in the tube. My gases (CO and O) are therefore on the verge of liquefaction, as this mist is only produced when vapours are about to liquefy.

"L. CAILLETET.

"December, 2, 1877."

M. H. Sainte-Claire Deville added the following explanations:—M. Cailletet has repeated his experiments on the condensation of oxygen, on Sunday, December 16th, in the laboratory of the Normal School: they have succeeded perfectly, as has been stated in the foregoing note. If this note has not been made public earlier it is because M. Cailletet was a candidate for the position of Correspondent, which the Academy awarded to him in the Session of December 17, and he did not wish to introduce into the discussion of his claims, on December 10th, researches whose results have not been confirmed by an experiment made before competent judges. On the 17th of December, the day of his election, he did not think it becoming to publish a fact of great importance, indeed, but the discussion of which could not take place in the secret committee of December 10th; fortunately I had taken the precaution, on December 3rd, to have the letter containing the announcement of his discovery sealed up and signed by the Perpetual Secretary. The priority belongs to him, therefore, in an incontestable manner. Still the remarkable investigation of M. Raoul Pictet must not be considered as having received any injury, his method of procedure being absolutely different from that employed by M. Cailletet. The process of refrigeration founded upon the escape of a gas or of a vapour, a principle not yet applied, and the simplicity of M. Cailletet's apparatus, will enable the condensation of gases to be shown as an instructive lecture experiment. M. Jamin admitted that the possibility of liquefying or solidifying oxygen was now demonstrated; the two experiments were of equal value; that of M. Pictet added little to that of M. Cailletet, for if the former announces that he has seen the oxygen precipitated in the liquid state everything indicates that it was but a fugitive glimpse, and, on the other hand, the mist observed by M. Cailletet at the instant of escape shows that the oxygen had ceased to be transparent,—that is to say, gaseous,—and had become solid or liquid. To have seen the liquid or the mist, without collecting either, is all one. The final experiment is still to be made: it will consist in maintaining the oxygen liquid at its boiling-point, as has been done with nitrous oxide, or in a solid state like carbonic acid, which is preserved in that condition on account of the enormous latent heat which its gaseifaction would require. There is every reason to hope that the two skilful experimentalists may ultimately meet in this ultimate result. M. Dumas, after what had been said, regarded the mutual independence of the researches of MM. Cailletet and Pictet as absolutely certain. Each one, pursuing the same object, and creating methods and apparatus, has arrived at the same result without any knowledge of the work of his rival. M. Regnault informed the Academy that he had assisted, five years ago, at the first attempts made at Geneva, by M. R. Pictet and M. de la Rive, to obtain the liquefaction of gases. He had been struck with the remarkable arrangement of the apparatus. M. Berthelot, without denying the originality of M. Pictet's experiment, showed that M. Cailletet's researches on the liquefaction of oxygen are the necessary continuation of his researches on the liquefaction of binoxide of nitrogen, published in the *Comptes Rendus* (Nov. 26, p. 1016), and on the liquefaction of ethylen (Nov. 5, p. 851).

New Observations on the Part played by Pressure in Chemical Phenomena.—M. Berthelot.—The author called the attention of the Academy to one of the circumstances of M. Pictet's remarkable experiment. The decomposition of chlorate of potassa into oxygen and chloride of potassium—an exothermic reaction, and not limited by its inverse—is not arrested by a pressure of 320 atmospheres. It is probable that the speed of the reaction is changed, and perhaps also the temperature at which it is effected, but the reaction itself does not cease to take place. This is a further confirmation of the opinions enounced by the author of the present note on a question of such importance for chemical mechanics—opinions contested at first, but which new observations support more and more.

Experimental Researches on Rotatory Magnetic Purification; Magnetic Rotations of Luminous Rays of different Wave-lengths.—H. Becquerel.—The author's experiments show what differences exist between positive and negative magnetic rotations. The ratios of the positive rotations of the various luminous rays are approximately represented by the expression—

$$\frac{n^2(n^2-1)}{\lambda^2},$$

where n represents the index of refraction and λ the wave-length, whilst those of the negative rotations differ little from those deduced from the formula—

$$\frac{n^2(n^2-1)}{\lambda^4}.$$

The positive magnetic rotations of different bodies seem to tend towards a limit depending solely on the index of refraction and on the wave-length, whilst the negative rotations show a much better-marked action of the magnetism developed in the molecules of the substances.

On the Acid Acetates (continued).—A. Villiers.—The author, in this paper, describes certain acetates of strontia, baryta, copper, and manganese.

MEETINGS FOR THE WEEK.

MONDAY, 28th.—Medical, 8.
—— London Institution, 5.
—— Royal Geographical, 8.30.
—— Society of Arts, 8. "Explosions in Coal Mines," by Thomas Wills, F.C.S.
TUESDAY 29th.—Civil Engineers, 8.
—— Anthropological, 8. (Anniversary).
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
WEDNESDAY, 30th.—Society of Arts, 8. "The Art Manufactures of Japan," Christopher Dresser. Ph.D.
THURSDAY, 31st.—London Institution, 7.
—— Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
FRIDAY, Feb. 1st.—Royal Institution, 8. Weekly Meeting. "The Telephone," Mr. W. H. Preece, 9.
—— Geologists' Association, 8. (Anniversary).
—— Society of Arts, 8. (Indian Section). "The Destruction of Life in India by Wild Animals," by Sir Joseph Fayrer, M.D., K.C.S.I.
SATURDAY, 2nd.—Royal Institution, 3. "Carthage and the Carthaginians," R. Bosworth Smith, M.A.
—— Physical, 3. (Anniversary).

TO CORRESPONDENTS.

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WATER ANALYSIS.—Prof. WANKLYN, Lecturer on Chemistry and Physics at St. George's Hospital, Public Analyst for Buckinghamshire, Buckingham, High Wycombe, Peterborough, and Shrewsbury, has REMOVED to 7 Westminster Chambers, Victoria Street, S.W.

THE CHEMICAL NEWS.

Vol. XXXVII. No. 949.

ON DYER'S CHEMICALS.

By J. MARZELL.

(Continued from p. 35.)

Methyl-Aniline.*

The methods for methylating aniline being so very various, we shall discuss only those having the most interest for industry.

1. A mixture of 100 parts hydrochlorate of aniline and 50 to 80 parts methyl-alcohol is heated up in an autoclave for several hours. The temperature is carried to 175° to 210° C., and maintained for three or four hours, or even may be raised to 250° to 300° C., in which case the change takes place in two or three hours, or thereabouts. In the latter case great care has to be taken at the beginning of the reaction. At about 280° C. the temperature and the pressure rise suddenly, and therefore, immediately when it occurs, the fire bas to be removed till the pressure abates; then it is put on again.

After the reaction the hydrochlorate of the new body remains, and is decomposed by means of soda, potash, or ammonia, and the mixture of mono-, di-, and even tri-methyl-aniline separated by fractional distillation.

The different points of the reaction may be represented in the following figures:—

I. $C_6H_5NH_2,HCl = C_6H_5NH_2 + HCl$.
Decomposed by heat.

II. $CH_3OH + HCl = CH_3Cl + H_2O$.

III. $\left.\begin{matrix}C_6H_5\\H\\H\end{matrix}\right\}N + CH_3Cl = \left\{\left[\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\}N + HCl\right]$.

IV. $\left.\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\}N + CH_3Cl = \left\{\left[\begin{matrix}C_6H_5\\(CH_3)_2\end{matrix}\right\}N + HCl\right]$.

V. $\underset{\text{Hydrochlorate.}}{\left[\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\}N,HCl\right]} + KOH = \underset{\text{Free base.}}{\left\{\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\}N} + KCl + H_2O$.

2. By mixing aniline with an alcohol and a salt, by preference the chlorides, bromides, or iodides of aluminium, calcium, magnesium, zinc, iron, or other metal. By preference 100 parts aniline, 100 to 150 parts methyl-alcohol, and 80 to 100 parts sal-ammoniac are mixed and heated under pressure to 275° to 300° C., which heat is maintained for two to four hours.

When the reaction is complete the liquid separates into two parts, one of which is oily and contains the new alkaloids. It is digested and purified by washing and distilling.

The reaction takes place in the way above mentioned; the sal-ammoniac is split up into ammonia and hydrochloric acid,—

$$NH_3.HCl = NH_3 + HCl.$$

In consequence of the free NH_3, which forms NH_3HCl again at the end of the reaction, the methyl-anilines are obtained as free bases at once.

3. By action of alkaline haloids (chlorides, bromide iodides) upon aniline, the resulting products will be

a. Methyl-anilines.
b. Hydrate of the used halogen.

I. $\left.\begin{matrix}C_6H_5\\H\\H\end{matrix}\right\}N + CH_3I = \left\{\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\}N + HI$.

II. $\left.\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\}N + CH_3I = \left\{\begin{matrix}C_6H_5\\CH_3\\CH_3\end{matrix}\right\}N + HI$.

III. $HI + KOH = H_2O + IK$.

In taking methyl-iodide great attention is necessary, as the reaction is very violent.

To isolate the methyl-anilines (for there will always be a mixture of mono- and di-derivatives) the melt is decomposed by a concentrated solution of caustic soda or potash. The methyl-anilines are obtained as oil swimming on the surface, are drawn off, washed, and re-distilled.

The autoclave used for this process has to be provided with an arrangement allowing to supply the reagents whilst the operation is going on. This machinery consists of a tube of about 4 inches diameter and 8 inches high, diminished at both ends, and closed by means of cocks. On the top of the upper cock a funnel-shaped head-piece is fixed. The bottom part is screwed into the cover of the vessel.

The operation is effected in the following way:—The bottom cock is shut, the upper one opened, and a part of the respective alkaline haloid put into the tube. Now, by closing the upper cock and opening the bottom one, the communication between the inner part of the autoclave and the tube being affected, without losing any pressure, &c., the stuff is allowed to run in.

The reaction is very violent, and therefore the calculated quantity of alkaline haloid to be added in small portions. As soon as the addition takes place temperature and pressure rise suddenly, and therefore the refrigerator has to be in work. As soon as the falling of temperature and pressure shows the end of the reaction a fresh lot is put in, by manipulating with the cocks in the manner mentioned above, and so on, till all is mixed. Then, after stopping the refrigerator, it is advisable to keep the temperature up at 100° C. for one or two hours. For this purpose the autoclave is set in brickwork, with a fireplace beneath, in such a manner that the flame from the fire may not play directly on the vessel, but the heated air and products of combustion from the fire circulate in flues surrounding the bottom and sides of the vessel.

The apparatus is allowed to cool down, then opened, the necessary quantity of caustic soda supplied, the methyl-anilines digested, washed, and re-distilled, either out of the autoclave itself or from a still especially kept for this purpose.

In reference to the recovery of the used halogen (which is as alkali compound in the residues) Mr. Wanklyn's* process is of great interest. He treats iodide of potassium (KI) or sodium (NaI) with its weight of hydrochloric acid, diluted in methylated spirit (CH_3OH), and distils the mixture. By adding water to the resulting distillate the methyl-iodide is precipitated in a pretty pure state.

4. By mixing together under pressure an alcoholic salt (nitrate or chloride by preference) and aniline, either in equivalent portions or 2 parts of alcoholic salt to 1 part of aniline.

The heat depends on the salt which is used. Taking the nitrate, only 100° C. are to be supplied for three or four hours; but if the alcoholic chloride is employed the heat should be raised to 220° C., or thereabout.

In operating with nitrate the process may be conducted in an earthenware or iron vessel without heat, at the common temperature, but then it will require several days.

* Poirrier and Chappat, *Bull. de la Soc. Chimie*, 1866, vi., p. 502. Patent No. 1912. Ch. Girard and De Laire, "Derivés de la houille" Paris, 1872). A. Würtz, "Matières Colorantes Artificielle" (Paris, 876).

* *Bull. de la Soc. Chimie*, 1867, vii., p. 92. Brevet No. 73,160.

The resulting salts of the alkaloid are then decomposed by alkalies.

5. Equal parts of aniline, hydrochloric acid, and methylated spirit are brought together, and treated with elevated heat at a certain pressure.

The autoclave used is enamelled inside, provided with a safety-valve, a pressure-gauge, and a cock of about ¾ inch, and plunged into an oil-bath. Charged with the materials, a heat of 200° to 220° C. is supplied, the pressure raising up to 25 atmospheres.

The reaction takes place in two parts:—

A. The hydrochloric acid acts upon the methylated spirit, forming chlor-methyl,—

$$CH_3OH + HCl = CH_3Cl + H_2O.$$

B. The chlor-methyl converts the aniline into methyl-aniline,—

$$\text{I.}\quad \left.\begin{matrix}C_6H_5\\H\\H\end{matrix}\right\} + CH_3Cl = \left\{\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\} N + HCl.$$

$$\text{II.}\quad \left.\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\} N + CH_3Cl = \left\{\begin{matrix}C_6H_5\\(CH_3)_2\end{matrix}\right\} N + HCl.$$

In mixing the bodies hydrochlorate of aniline—

$$(C_6H_5NH_2.HCl)$$

will necessarily be formed, but as it is decomposed at 240° C. (according to M. Würtz), with that pressure and heat it will certainly be set free for action.

It is to be observed that the HCl decomposed in A is recovered in B, ready to operate upon another part of alcohol.

Working in this manner, especially dimethyl-aniline—up to 80 to 95 per cent of the aniline started with (Würtz)—is formed.

According to Kern* in this way dimethyl-aniline only will be obtained; and even by interrupting the operation purposely, besides non-attacked aniline no mono-methyl-aniline is to be found. The methyl groups are substituted for the two amido hydrogens.

Ch. Girard† states that, in heating up to 190° to 200° C. a mixture of 100 parts aniline, 120 parts HCl (sp. gr. 1·17), and 38 parts methyl-alcohol, only mono-methyl-aniline, and no di-derivative, is formed.

Whichever way may be followed, after cooling, the autoclave is unscrewed and milk of lime added in a small excess. The free base, swimming on the surface, is digested and re-distilled by steam.

The mass so obtained consists of free aniline, mono- and di-methyl aniline.

By adding hydrochloric acid the aniline is converted into hydrochlorate of aniline ($C_6H_5NH_2HCl$), which precipitates, whilst the HCl salts of the methyl-anilines remain in solution, and can be separated by filtering and pressing.

The separation of the mono- and di-methyl aniline is more difficult to carry out. Commonly fractional distillation is taken as expedient; but in this case it is not of much use, as the boiling-points of the two substances are so very close together.

To isolate mono-methyl aniline from the mixture, A. W. Hofmann takes advantage of the fact that only the mono-methyl aniline is able to form an acetyl compound which can be separated from the dimethyl-aniline according to its properties both of crystallisation or distilling.

The formula shows the reaction as follows:—

$$\left.\begin{matrix}C_6H_5\\CH_3\\H\end{matrix}\right\} N + \left\{\begin{matrix}C_6H_5\\CH_3\\CH_3\end{matrix}\right\} N + C_2H_3OCl =$$

$$= \left\{\begin{matrix}C_6H_5\\CH_3\\C_2H_3O\end{matrix}\right\} N + \left\{\begin{matrix}C_6H_5\\(CH_3)_2\end{matrix}\right\} N, HCl.$$

* *Berichte der Deutsche Chem. Gese.l.*, 1875, p. 771.
† *Bull. de la Soc. Chem.*, xxiv., 121.

The conversion into acetyl-derivative can be effected either by acetic acid anhydride, or, better, by acetyl-chloride. The stuff to be treated is brought into a balloon provided with a refluxing condenser and an arrangement like a separating-funnel, allowing to supply the acetyl-chloride gradually. As soon as acetyl chloride is added heating arises, and the end of the reaction can be seen on cooling. If on the addition of a fresh quantity no more reaction can be observed, it shows that all mono-methyl-aniline is converted into its acetyl-derivative. The whole product is then put into hot water, from which the methyl-acetanilide crystallises out on cooling.

The dimethyl-aniline is digested and re-distilled. As the acetanilide only distils at 240° to 250° C., there is no fear that it would spoil the distillate of dimethyl-aniline. By decomposing the acetyl compound mono-methyl-aniline is obtained in a state of great purity.

The reaction by which the methyl-anilines are formed also produces a quaternary base, the chloride of the trimethyl-phenyl-ammonium—

$$\left.\begin{matrix}C_6H_5\\CH_3\\CH_3\end{matrix}\right\} N + CH_3Cl = \left\{\begin{matrix}C_6H_5\\CH_3\\CH_3\end{matrix}\right\} N\!<\!\begin{matrix}CH_3\\Cl\end{matrix}$$

That chloride remains in the aqueous solution, from which the methyl-anilines were digested as oils. By evaporating this solution (containing lime in suspension) to dryness, and distilling the residue by heat.

A. The lime acts upon the chloride, recovering the free base—

$$Ca\left\{\begin{matrix}OH\\OH\end{matrix}\right. + 2\left\{\begin{matrix}C_6H_5\\(CH_3)_2\end{matrix}\right\} N\!<\!\begin{matrix}CH_3\\Cl\end{matrix}\Big\} =$$

$$= CaCl_2 + 2\left\{\begin{matrix}C_6H_5\\(CH_3)_2\end{matrix}\right\} N\!<\!\begin{matrix}CH_3\\OH\end{matrix}.$$

B. By dry distillation this base is decomposed into methyl-alcohol and dimethyl-aniline.

$$\underbrace{\left\{\begin{matrix}C_6H_5\\(CH_3)_2\end{matrix}\right\} N\!<\!\begin{matrix}CH_3\\OH\end{matrix}}_{\text{Base.}} = \underbrace{\left\{\begin{matrix}C_6H_5\\(CH_3)_2\end{matrix}\right\} N}_{\text{Dimethyl-aniline.}} + \underbrace{CH_3OH}_{\text{Methyl-alcohol.}}.$$

As a test for aniline, the violet reaction by treating an aqueous solution with chloride of lime may be considered quite sufficient (Kern).

The contradictory results of Kern* and Hepp† against the observations of Hofmann‡, Girard and de Laire,‖ and others, about the formation of mono-methyl-aniline, besides the dimethyl product, induced E. Nölting and I. Boas-Boasson§ to take up again the respective researches. To separate the secondary amine from the products of reaction, containing besides aniline and dimethyl-aniline they follow E. Fischer's method.¶

The acid solution—not too concentrated, and well cooled down—is treated with nitrite of soda ($NaNO_2$). Aniline will thereby be converted into diazo-benzol-chloride, dimethyl-aniline into hydrochlorate of nitroso-dimethyl-aniline, both remaining in solution, whilst the formed methyl-phenyl-nitrosamine gathers as a yellow oil, which can be taken out by ether. For reducing that nitrosamine (with Sn+HCl or $Fe+C_2O_2H_4$), methyl-aniline is got quantitatively, and showing all the characteristic reactions.

To examine a solution for methyl-aniline, about 1 grm. of the mixture is diluted in slightly weakened hydrochloric acid, a few drops of a solution of the nitrite are added, and the whole shaken with ether. The ethereal extract is dried with chloride of calcium, and evaporated down in a watch-glass on the water-bath. The methyl-phenyl-nitrosamine remains in yellow drops, and can be

* *Berichte der Deutsch. Chem. Gesell.*, 1875, 771.
† *Ibid.*, x., 327.
‡ *Ibid.*, v., 720, and viii., 523.
‖ Matieres colorantes.
§ *Berichte der Deutsch. Chem. Gesell.*, x., 795.
¶ *Ibid.*, viii., 1641.

recognised by its characteristic smell and by Liebermann's reaction.

E. Nölting and I. Boas-Boasson found the yield of mono-methyl-aniline pretty considerable.

(1.) 50 grms. of a mixture of bases, got by the action of 1 mol. iod-methyl upon 1 mol. of aniline, yielded 21 grms. of dry nitrosamine, equal to 16·5 grms. of methyl-aniline.

(2.) 50 grms. of a mixture of bases got by action of 1 mol. of iod-methyl upon 2 mols. of aniline, and separated from iod-hydrate of aniline by ether, yielded 23·5 grms. nitrosamine, equal to 18·5 methyl-aniline.

(3.) The product of reaction of 25 grms. (CH_3OH) methyl-alcohol upon 100 grms. of hydrochlorate of aniline at 235 to 240° C., resulted in 23 grms. of methyl-aniline.

The possibility of forming the methyl-aniline in the technical process is therefore not to be doubted, and the authors really had the opportunity to prove the presence of small quantities of mono-methyl-aniline in two samples of commercial dimethyl-aniline; also a diathyl-aniline yielded small quantities of athyl-phenyl-nitrosamine.

The reaction is a very sharp one, and allows even 1 per cent of methyl-aniline to be detected with certainty.

(To be continued).

ON THE

ESTIMATION OF THE NITROGEN COMPOUNDS IN THE OIL OF VITRIOL OF COMMERCE.*

By GEORGE E. DAVIS.

In December, 1871, Mr. W. Crowder published a paper upon this subject, which was followed by one written by myself, and published in the Chemical News in December, 1871, and January, 1872, and in answer to a query in March, 1872, I gave a *resumé* of the oxidation processes mentioned in the former papers, and so far the subject has remained at rest until September, 1877, when Prof. Lunge communicated some interesting experiments, which appeared in the Chemical News.

It is a curious fact, that although the numbers obtained by the various oxidation processes correspond to the real amounts of nitrogen compounds present, yet this is only the case with certain varieties of vitriols, and the action of the arsenious acid which most vitriols contain has never been commented upon, though it is certain that this compound must have a deoxidising tendency towards the standard oxidising solutions used. In fact, in the three papers alluded to the mention of arsenious compound only occurs in the first portions of my paper (Chem. News, xxiv., p. 258).

It must be evident to every chemist that if arsenious acid existed in the vitriol, the process of examination by either the chloride of lime, or the permanganate method, or the bichromate method, one of which is at present employed in most works, would be incorrect, seeing that arsenic acid would be produced from the arsenious compound, and the amount of the deoxidation would be reckoned as nitrous acid.

The methods of oxidation alluded to can only be exact, or approximately so, when the arsenic compounds are in a state of peroxidation, and the vitriol is free from organic matter and proto-salts of iron, and also when the oxides of nitrogen are all in the same degree of oxidation, and that degree positively known.

It is therefore certain that none of the oxidation methods can be used for estimating with certainty the amount of nitrogen compounds in ordinary pyrites vitriol, and further on I shall proceed to show that only under certain conditions is it permissible to use an oxidation process for the estimation of the nitrogen compounds in brimstone vitriol.

* A Paper read before the Faraday Club.

Oil of vitriol is not such a simple substance as some may imagine. I have found it to contain—

Nitric oxide	Ferrous sulphate
Nitrogen trioxide	Organic matters
,, tetroxide	Sulphurous acid
Nitric acid	Hydrochloric acid
Arsenious acid	Sulphuric acid
Arsenic acid	

I do not mean to infer that all these substances have been found in the same sample of vitriol, but *nearly* all of them have been found in the same sample, and it may be seen that any method of analysis must be one which does not depend upon the deoxidation of standard solutions.

The conversion of the nitro-compounds into ammonia is tedious and difficult in the presence of so much free sulphuric acid. Nitrate of urea is much too expensive to be used in a technical laboratory even if the process was satisfactory, which it is not; and as it is a rapid, easy, and accurate process, under all conditions, which is required, I have great pleasure in laying such a process before you this evening.

In January, 1872, soon after the publication of my paper, I carried on a little correspondence with Dr. John Watts, who advised me to try a modification of Walter Crum's method for the estimation of nitrates in potable waters, basing his advice upon some experiments of his own, saying also that "no nitrogen compound could escape being reckoned."

I have carried on these experiments since that date, not daring to publish anything upon the subject until I had operated upon every variety of vitriol capable of being obtained, and working under every condition which might be required in practice. And, again, I had considered the process exclusively Dr. Watts's, and hoped that he would have brought his process before the notice of technical chemists long since. The method is very simple, and may be briefly described as follows:—

1 c.c. of the vitriol is measured very accurately by means of a fine pipette, and introduced into Frankland's stopcock-tube, standing over mercury. By opening the stopcock the vitriol is allowed to run in, and the cup is washed out with pure strong vitriol, which is also run into the tube. The bottom is now closed with the thumb, and the vitriol agitated with the mercury in such a manner that an unbroken column of mercury always remains between the vitriol and the thumb. The reaction is complete in less than five minutes, and the tube being graduated, the mercury is levelled, and the volume of gas read off. For technical purposes this volume will be found accurate enough, but in cases where extreme accuracy is required the tube must be left to itself for several hours, the temperature and pressure noted, and the necessary corrections made.

The mercury reduces the whole of the nitrogen oxides to nitric oxide (N_2O_2), and the presence of any other compound found in vitriol has no influence on this test. The only precaution to be taken is to have the vitriol in the tube strong enough.

In order to avoid the expense of a deep and well-filled mercury-trough I have designed the one you now see upon the table. There is a well at one end of the trough in which to depress the tube for reading off, and the amount of mercury required to fill the trough is scarcely ten pounds. Messrs. Mottershead, of Manchester, are the makers of these troughs.

It is rather a curious coincidence that when 1 c.c. of vitriol is taken the number of c.c. of N_2O_2 obtained divided by ten gives nearly enough the percentage of N_2O_3. This happens when the vitriol has a density of about 143° T.

This process has been in use with me since 1872, and by its means I have been able to follow well and truly

many interesting reactions connected with the oil of vitriol manufacture.

Processes like the permanganate or bichromate, which depend upon the use of oxidising agents, are of no value at all, and though they sometimes give numbers closely approximating to the real quantities of nitrous acid present, yet those numbers are only obtained by a happy combination of errors, which any slight alteration in the mode of manufacture might soon overturn.

I have been experimenting upon the vitriol of a works all made from the sulphur contained in the spent oxide of iron from gas-works. This vitriol contains no arsenic. There are six chambers working: the mixed gases pass into No. 1 chamber, and exeunt from No. 6. The following results were obtained by the two methods, permanganate and mercury:—

Description.	Sp. Gr.	P. c. N_2O_3 by Permanganate.	P. c. N_2O_3 by Mercury.
Strong acid	1·78	0·008	—
No. 1 chamber ..	1·56	0·024	—
No. 2 ,, ..	1·55	0·017	—
No. 3 ,, ..	1·53	0·172	0·144
No. 4 ,, ..	1·57	0·218	0·228
No. 5 ,, ..	1·47	0·038	0·039
No. 6 ,, ..	1·43	0·024	0·071

The above calculations were made upon the basis that 1 litre of nitric oxide at 0° and 760 m.m. weighs 1·343 grms.

It will be seen from the above table that in the concentrated acid, and in the chambers 1, 2, and 3, the permanganate process has given results in excess of the truth; in fact the permanganate has estimated the proto-salt of iron in No. 1, the organic matters in Nos. 2 and 3, and in Nos. 4 and 5 only do we get the exact measure of the nitrous acid present. In No. 6 the mercury process gives results much in excess of the permanganate, therefore it is evident that of the total nitrogen compounds present in the vitriol some of them must be fully oxidised. This means that there exists in the vitriol from this chamber 0·024 per cent of nitrogen trioxide, the remainder as nitric acid.

Direct evidence of the presence of nitric acid in the vitriol from the last chamber is often obtained in vitriol works. It has often been noticed that when the last chamber of the series has been worked very weak the lead has been rapidly worn away—in fact, worn completely in holes—more especially upon the top liquor-line; this is due to the formation of nitric acid. But as this is not immediately connected with the subject of my paper I am forced to leave it.

What little I have said—and the process requires but little explanation—will lead you to see that the mercury process is one very rapid, easy of application, and accurate. There may be present in ordinary oil of vitriol every impurity ordinarily found without affecting the results.

I have found this process of especial use in the estimation of the nitrous acid in the waste acid from the aniline works. This waste acid at 116° T. has generally been sold on the basis of containing 3 to 4 per cent of nitrous and nitric acids. But on a thorough examination of this acid from several works, though the permanganate process shows 3 to 4 per cent, yet the mercury process scarcely shows 1 per cent.

In 1872, when Dr. John Watts wrote me upon the subject, I sent him some samples which I had previously examined by the permanganate process, and he returned me the following results:—

	Vol. N_2O_3 Roughly.	Vol. N_2O_3 Accurately.	Per cent Davis.	Per cent. Watts.	Difference.
1.	11·48	11·44	{1·229 / 1·204}	1·138	0·079
2.	10·62	10·72	1·156	1·059	0·097
3.	9·25	9·18	1·000	0·920	0·080
4.	12·25	12·25	1·263	1·229	0·034

Three analyses of the same samples gave—

I.	II.	III.	IV.
11·65	10·77	9·20	12·25
11·46	10·60	9·25	12·20
11·34	10·50	9·30	12·30

These results, which I received in 1872, were followed up by some made by myself upon vitriol made from Mason's ore, which were as follows:—

	Sp. Gr.	P.c. N_2O_3 Permanganate.	P.c. N_2O_3 Mercury.
From absorber	1·75	1·742	1·688
From concentrator ..	1·71	0·142	—
Chamber acid used ..	1·57	0·092	0·023
Leading chamber 1 ..	1·56	0·092	0·027
,, 2 ..	1·55	0·068	0·012
,, 3 ..	1·45	0·144	0·146
,, 4 ..	1·45	0·031	0·036
,, 5 ..	1·40	0·049	0·062
Exit chamber 6 ..	1·35	0·042	0·083

Here we have the same results as in the spent oxide acid. The arsenious acid deoxidises the permanganate in the first two chambers, in Nos. 3 and 4 the nitrous acid exists unoxidised, whilst in Nos. 5 and 6 there exists both nitrous and nitric acids.

In 1877 I obtained the following results from oil of vitriol made from Rio Tinto ore:—

	Sp. Gr.	P.c. N_2O_3 Permanganate.	P.c. N_2O_3 Mercury.	Per cent. As_2O_3.
From absorber ..	1·745	0·631	0·614	0·437
From concentrator	1·745	0·206	0·009	0·542
Leading chamber 1	1·665	0·125	0·032	0·192
,, 2	1·645	0·219	0·207	0·093
,, 3	1·620	0·305	0·315	0·005
,, 4	1·570	0·140	0·187	trace
,, 5	1·535	0·113	0·110	,,
,, 6	1·505	0·189	0·226	,,
Exit chamber 7	1·595	1·441	1·504	,,

Nitric acid is found again in the last two chambers, and it will be noticed how nearly the permanganate results agree with the actual amounts of nitrogen oxides found, so that it would seem that there are no other compounds capable of being oxidised than the nitrous acid in the nitro-sulphuric acid from the Gay-Lussac absorbing column, and that the method of oxidation by either the permanganate or bichromate is allowable in this case; but I hope to treat of this more fully in a paper I am preparing to read shortly upon "Nitric Acid in the Vitriol Manufacture, and where does it go to?"

Barton Arcade, Manchester,
December 19, 1877.

ON THE

LAW OF THE ABSORPTION OF RADIATIONS ACROSS BODIES,

AND OF

ITS APPLICATION IN QUANTITATIVE SPECTRAL ANALYSIS.

By M. G. GOVI.

PART I.

If an absorbent medium is interposed in the path of the white light which passes by the slit of the spectroscope, we generally see obscure bands appear in different parts of the spectrum, which diminish the brightness of the colours and even extinguish them completely. It is very rare that these bands do not encroach upon a large number of the lengths of contiguous waves. If we

augment the thickness of the absorbent medium we often see new shaded bands appear between the former, but there invariably occurs a deepening and a progressive dilatation of the first bands, so that for a certain thickness of the medium the whole spectrum is invaded by the shadow and enfeebled to such an extent that it may be regarded as altogether extinct.

This progressive enlargement of the absorption-bands strikingly recalls the increase in number, and the dilatation of the luminous rays, which many observers have remarked in the spectra of incandescent gases in proportion as their rarefaction is diminished and their temperature increased. All the rays of the spectrum, visible and invisible, present analogous phenomena, and if only the luminous rays are mentioned here it is because their study is more convenient and more general than that of the ultra-red or ultra-violet radiations.

It is easy to see that the absorbent power of any substance is not sufficiently characterised by the appearance of such or such a dark band in the spectrum of white light which has traversed such or such a thickness of it. It is needful to know all the modifications which it may produce in the spectrum from the feeblest and the most limited up to that which produces the apparent extinction of all radiation.

To observe directly spectral curves of equal absorption it is sufficient to give to the absorbent bodies the form of a prism, more or less acute, which is applied by one of its plane surfaces against the slit of the spectroscope. The edge of the prism is placed at one of the ends of the slit, parallel to its width, and there is thus obtained, over the whole length of the aperture, an absorbent medium, the thickness of which increases uniformly from zero (at the place of the angle) up to a certain maximum, which depends on the angle of the prism and on the length of the slit. The deviation due to the prismatic form of the medium may be destroyed by opposing to the first prism a second, of a material as little absorbent as possible, such as rock-salt, fluor-spar, quartz, glass, water, or alcohol, &c. The angle of the second prism is easily calculated by approximation, but, in case of need, it may be rendered variable within limits sufficiently wide to ensure a compensation almost perfect.

If we place in this manner an absorbent medium of variable thickness before the slit of a spectroscope illuminated by perfectly white light, *i.e.*, the light of incandescent solid bodies, the spectrum no longer appears, as ordinarily, uniformly luminous in all its height, but we distinguish in it shadows, more or less undulated or denticulated, which represent to the eye the law, according to which the coefficient of absorption of the medium varies with the wave-length of the incident light. If we divide the slit into two parts in the direction of its length, and employ each of these two parts to produce a spectrum with curves of chromatic absorption, the two spectra will be found in juxtaposition in the direction of their length, and it will be easy to compare the curves and recognise their equality or their differences. We may even by a very simple artifice cause two spectra of one and the same absorbent medium in two different degrees of concentration to slide one over the other, recognising thus zone of equal intensity, and thus apply the spectroscope to the quantitative determination of the substance used as a medium.—*Comptes Rendus.*

SUSPENSION, SOLUTION, AND CHEMICAL COMBINATION.*

By WILLIAM DURHAM, F.R.S.E.

SOME time ago I made some experiments on "suspension of clay" in water, in acid, and in saline solutions. These formed the subject of several communications to the Royal Physical Society of Edinburgh, and an abstract was afterwards published in the CHEMICAL NEWS. I shall describe some of these experiments as an introduction to this paper.

1. *Clay in Water.*—A few grains of fine white clay were stirred up in about a pint of pure water, in a glass jar. The time which the water took to clear, and the clay to deposit itself in the jar, was noted, and found to be about thirty hours.

2. *Clay in Acid Solutions.*—To a similar quantity of clay and water were added a few drops of acid, and the time of clearing again noted. In this case the time was from half an hour to one hour, according to the quantity of acid used.

3. *Clay in Salt Solutions.*—In place of acids, salts of various kinds were added to the clay and water, and the effect in every case was to shorten the time of precipitation of the clay, according to the kind and quantity of the salt used.

In endeavouring to ascertain the cause of these phenomena I was led to experiment on various solutions, and obtained results which appear to me very interesting and to open up a line of research likely to lead to important results as to the laws of solution and chemical affinity. The following are the more important facts as yet determined:—

1. NaCl and HCl.—To a saturated solution of sodium chloride was added strong hydrochloric acid. Salt was rapidly precipitated on each addition of acid. This action is usually described as sodium chloride is insoluble in hydrochloric acid, but the mode of action does not seem to have attracted much attention. The following experiments throw some light on the matter:—

2. $Na_2SO_4 + 10H_2O$ and HCl.—To a saturated solution in water of sodium sulphate was added strong hydrochloric acid. *Anhydrous* sodium sulphate was precipitated. The precipitate was immediately dissolved on a further addition of hydrochloric acid. In this case it cannot be said that anhydrous sodium sulphate is insoluble in hydrochloric acid, as it easily dissolves in excess of acid. The action seems analogous to what occurs when ammonia is added to a zinc salt. Zinc oxide is first precipitated, and then dissolved again as excess of ammonia is added. The next experiment makes the action more apparent.

3. Crystals of $Na_2SO_4 + 10H_2O$ and HCl.—Strong hydrochloric acid was poured over some crystals of sodium sulphate. The crystals were rapidly broken up, the water uniting with the hydrochloric acid, while the anhydrous salt was left undissolved. As in No. 2, however, on the addition of excess of acid, the anhydrous salt was at once dissolved.

4. $CaCl_2$ and HCl.—To a saturated solution in water of calcium chloride was added some strong hydrochloric acid. No action was apparent. As calcium chloride has a great affinity for water, I concluded that the affinities were balanced in the two solutions, and therefore there was no apparent action. To prove this, I added to the hydrochloric solution some fragments of solid calcium chloride, which, as anticipated, rapidly dissolved with effervescence, expelling hydrochloric acid gas copiously.

5. A weighed quantity of solid calcium chloride was dissolved in a measured quantity of water, and the rise in temperature noted: this was 15° F.

6. The same quantity of solid calcium chloride was added to strong hydrochloric acid, and the rise in temperature also noted: this was 6° F., being a difference of 9°, accounted for, no doubt, by the vapourising of the HCl gas expelled in the latter case.

7. NaCl and $CaCl_2$.—Calcium chloride, both in saturated solution and solid, was added to saturated solution of sodium chloride, and in both cases the sodium salt was precipitated, the calcium chloride taking its place in solution.

8. HCl and H_2SO_4.—Strong sulphuric acid was added to strong hydrochloric acid when the latter as gas was expelled with effervescence.

* From a Paper read to the Royal Society of Edinburgh, January 21st 18

9. $CaSO_4$, HCl, and H_2SO_4.—Strong sulphuric acid was added to a saturated solution of calcium sulphate in hydrochloric acid. Calcium sulphate was precipitated and hydrochloric acid gas expelled. I next looked for two solvents which would dissolve the same substance and yet precipitate it when mixed. These results I found with sulphuric acid, water, and calcium sulphate, thus:—

10. Two solutions (saturated) of calcium sulphate, one in water and one in sulphuric acid, were mixed. Calcium sulphate was deposited on cooling.

11. $CaSO_4$ in Water, and H_2SO_4.—To a saturated solution of calcium sulphate in water, sulphuric acid was added. Calcium sulphate was precipitated on cooling.

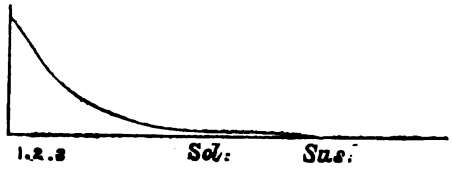
12. $CaSO_4$ in H_2SO_4 and Water.—To a saturated solution of calcium sulphate in sulphuric acid, water was added. Calcium sulphate was precipitated on cooling.

Three experiments, similar to Nos. 10, 11, and 12, were performed, only substituting clay in suspension for calcium sulphate in solution, and the results were similar. Clay in strong sulphuric acid was suspended nearly as long as in water, but on mixing the liquids, or on adding sulphuric acid to the water, or water to the sulphuric acid, the precipitation of the clay was greatly accelerated. Experiments 10, 11, and 12 seem to indicate that there is a point on one side of which water affinity is in excess, and on the other side sulphuric acid affinity.

I hope to extend these experiments to other substances than those already operated upon, and to enter more minutely into the various phenomena. So far as they go, however, they seem to point to certain conclusions which are interesting and suggestive:—

(1). *There seems to be a regular gradation of chemical attraction, from that exhibited in the suspension of clay in water up to that exhibited in the attraction of sulphuric acid for water, which we call chemical affinity.* The attraction between water and clay is neutralised by the stronger attraction between water and salts in solution. The latter, in its turn, is neutralised by the attraction between water and hydrochloric acid, which *almost* reaches the strength of a definite chemical compound. Then, finally, we reach water and sulphuric acid, which neutralise all the foregoing attractions and form more than one definite chemical compound.

(2). *That chemical combinations, solutions, and suspension differ only in degree, and are manifestations of the same force and definite chemical compounds, are just the points where the affinity exerts force enough to hold an exact number of atoms with a certain strength.* Chemical affinity should be studied in this connection as a regularly increasing force represented in the usual way by co-ordinates. For example, sulphuric anhydride, SO_3, might be represented by some such curve as the following:—



where 1 would represent the force by which 1 molecule of H_2O was held; 2 and 3 the force by which 2 and 3 molecules of H_2O were held. Sol.: the strength of attraction between SO_3 and H_2O, which prevents solution (say) of $CaSO_4$; and Sus.: the strength which prevents clay being held in suspension.

(3). *The attraction of chemical affinity is not, in every case at least, exhausted when a definite compound is formed, but has sufficient power left to form solution or suspension compounds.* Thus calcium sulphate is a definite chemical compound, but it still possesses sufficient affinity for sulphuric acid to enter into solution with it. This view might explain the researches of M. Stas on atomic weight. If he be correct he proved that Prout's law—that "the atomic weights of the elements are simple multiples of that of hydrogen"—is not correct, though very nearly so, the differences being very small. If it be true that the attraction of affinity is not entirely exhausted in a definite compound, but that there is a fraction of it, so to speak, to spare, we should only find Prout's law to hold good if we could analyse 1 molecule of any compound; but as in any analysis we can make there must be many molecules, each atom of these molecules having a fraction of its affinity for another atom to spare, these fractions would unite and hold in combination an extra number of the other atoms,—not so firmly perhaps, but still firmly enough to make the whole appear a definite compound on analysis; and this would affect the calculation for atomic weight. Thus suppose 2 atoms of Cl = 71 combine with 1 atom of Ca = 40, and still have 1-100th part of affinity to spare, then 200 atoms of Cl would take up 101 atoms of Ca, and from this analysis we should make the atomic weight of Ca not 40, but 40·4.

(4). *If chemical combination and solution are due to the same force, then solution will loosen the combination by spreading the affinity*, and possibly there may be a rearrangement of the soluble and solvent analogous to what is known to take place when two salts, having different acids and bases, are mixed. Thus, it appears to me, a drop or two of sulphuric acid added to a pint of water spreads its affinity equally through the whole pint of water; and this is the force which compels the water to drop or precipitate the clay. It further seems to loosen slightly the affinity of the H and O in the water, so that they are easier separated, as shown in the conduction of electricity. As more acid is added the effect is increased, until a point is reached where the quantity of water is no longer sufficient completely to neutralise the affinity of the sulphuric anhydride, which is shown by such phenomena as solution of $CaSO_4$ and increased resistance to electric conduction, because the SO_3 has begun to draw to itself more strongly the elements of the water, as its action is now concentrated on a smaller quantity.

If these views prove to be correct, many phenomena at present obscure would be readily explained.

ON THE

PRESENCE OF OXYGEN IN THE BESSEMER METAL.

By SERGIUS KERN, M.E. St. Petersburg.

IN a late number of the CHEM. NEWS (vol. xxxvii., p. 20 a method was proposed by the author for the estimation of oxygen in steels. An account of some new experiments on the same subject may be of use to metallurgists.

One thousand grms. of the Bessemer metal, taken out of the retort just before the addition of spiegeleisen, was cast in a small cast-iron mould. The casting was divided into two pieces: one of them was strongly hammered in a heated state; the second piece was left in its original form. The two specimens were tested for oxygen separately, by the method described in a former article on the same subject. It may be of use if I describe shortly an improved apparatus used for this purpose.

A strong porcelain tube, 0·250 metre long and 0·025 to 0·050 metre in diameter, was filled with 100 grms. of the specimen and placed in a long fire-clay furnace, heated by coke. Through the tube, during the ignition, nitrogen was passed, produced by heating ammonium nitrite (NH_4NO_2). The gas before entering the combustion-tube was well dried: this was executed by passing the current of gas, first, through a tube containing asbestos moistened with sulphuric acid, and, secondly, through a tube with fused calcium chloride. The gas liberated from the com-

bustion-tube with the nitrogen passes first through an U tube, containing a concentrated solution of potassium hydroxide (KHO) in pure ethyl alcohol, in order to absorb the carbonic acid and oxide (CO_2,CO) which may be present in the cast metal, as shown by the well-known experiments of Troost and Hautefeuille (*Comptes Rendus*, t. lxxvi., p. 562). From the ethyl alcohol tube the gas is lastly passed through a potash apparatus containing a concentrated solution of pyrogallic acid, $[C_6H_3(HO)_3]$, in water, in which is dissolved 20 to 25 per cent of potassium hydroxide. The ignition of the specimen must be continued for twenty hours, and the potash-apparatus is then quickly weighed; the increase in weight of the apparatus shows directly the percentage of oxygen.

The following are the results of my experiments:—

Hammered Specimen.

Experiment 1:—

	Grms.
Weight of the potash-apparatus after combustion	64·817
Ditto before combustion	64·652
Difference	0·165

Experiment 2:—

Weight of the potash-apparatus after combustion	64·829
Ditto before combustion	64·667
Difference	0·162

Non-hammered Specimen.

Experiment 1:—

	Grms.
Weight of the potash-apparatus after combustion	66·408
Ditto before combustion	66·223
Difference	0·185

Experiment 2:—

Weight of the potash-apparatus after combustion	66·735
Ditto before combustion	66·564
Difference	0·171

These specimens contain less oxygen than the samples analyses of which were given in a former article. Of course it is impossible to suppose that oxygen combines with steel in constant quantities, because the longer the blowing process is continued after the carbon of the metal in the converter (Bessemer apparatus) has been consumed, the greater percentage of oxygen may occlude in the refined metal.

Analysing an inferior steel rail, Mr. J. B. Britton, U.S.A., found 0·760: such metal, which we call burnt steel, is of no use whatever for manufacturing purposes.

Obouchoff Steel Works.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 8, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

THE PRESIDENT said that on the 31st of December last, at about 5.30 p.m., he was walking from Ainsworth to Bury, and he observed a large meteor which started from the star Pollux, and after making a slight curve upwards disappeared near the star Beta in Taurus. It seemed larger than the planet Venus, then brightly shining, and was of a yellowish white colour, and disappeared without breaking. It left a luminous track of its entire course for a short time after it had passed.

"*Note on the Decomposition of Water by Iron Pyrites*," by C. A. BURGHARDT, Ph.D. I have recently endeavoured to ascertain what part iron pyrites plays in the formation of the natural sulphides of other metals, such as copper glance, copper pyrites, &c. These and other sulphides are supposed to arise through the reduction of the corresponding *sulphates* of those metals by organic matter. Bischoff, in his "Chemical and Physical Geology," vol. iii., p. 554, says, "The production of sulphides presupposes the existence of sulphates; and the elimination of sulphur from sulphates, either in combination with hydrogen, or with the metals of the alkalies, or alkaline earths, presupposes the existence of organic life, since that effect would be produced only by carbonaceous substances. The influence of organic substances in the production of sulphides is further shown by the fossil remains, consisting of iron pyrites, blende, copper pyrites, variegated copper pyrites, sulphide of copper, and cinnabar." This theory appeared to me to be open to serious objections, as it would be very difficult to show the presence of organic matter in many crystalline rocks sufficient to produce the large sulphide formations often occurring in them through the reduction of sulphates. I therefore desired to ascertain whether sulphuretted hydrogen could be produced by simpler means, and in accordance with the occurrence of sulphides in rocks *free from organic matter*. With this view I placed some pure finely-powdered iron pyrites into a glass tube, covered it with perfectly pure distilled water (previously well boiled in order to drive out any air dissolved in it), placed the tube and its contents in a vessel containing boiling water, heated it gently for a short time to drive out any air which might have been contained in the tube, and sealed the latter up. After heating the above in an air-bath for four days, at a temperature of about 120° C., the tube was opened, when a very strong smell of sulphuretted hydrogen was instantly perceived, and proved to be present by its chemical reactions. The liquid contents of the tube were analysed, and found to consist of ferric sulphate, ferrous sulphate, and free sulphuric acid, whilst there was a slight deposit of ferric oxide upon the sides of the glass tube. This experiment certainly proves that sulphuretted hydrogen can be produced in the interior of the earth *without* the presence of organic matter, as all rocks (both crystalline and sedimentary) contain more or less iron pyrites disseminated throughout them, and are also saturated with water. I hope soon to determine quantitatively the reaction which occurs in the above experiment.

NOTICES OF BOOKS.

Annual Report of the Board of Regents of the Smithsonian Institution. Washington: Government Printing Office, 1877.

IN addition to the usual yearly reports of the Institution this volume contains a eulogy on Gay-Lussac, delivered by Arago, interesting without doubt, but which would have been much more valuable a quarter of a century ago. The researches and discoveries of the illustrious French chemist require no recapitulation, but the discourse contains some interesting incidents connected with his life. When travelling in Italy in company with Humboldt and Von Buch, he met at Naples strange treatment from a man who unfortunately bears an English name, a certain Dr. Thompson. "When they presented themselves, accompanied by a Neapolitan scientist, to study his museum, he addressed them in these outrageous words:

'Separate yourselves, gentlemen, I can keep my eyes on two, but not upon four." One feels tempted to ask in what society of Lazzaroni had Dr. Thompson borrowed sentiments so low and language so indecent; but all is explained when we learn that Thompson was the physician, friend, and confidential agent of General Acton, the instigator of the political assassinations which defiled Naples at the close of the last century." With all submission to Arago we think that more explanation is urgently needed.

In his celebrated balloon-ascent, the first undertaken from purely scientific motives, he reached the height of 23,000 feet, an elevation then perfectly unrivalled. "Having risen to 7000 metres he was desirous to soar still higher, and for this purpose rid himself of every article not absolutely needful. Among these was a white wooden chair, which fell by chance into a bush, near a girl guarding some sheep. What was the astonishment of the shepherdess? as Florian might have said. The sky was pure, the balloon invisible. How explain the chair if it came not from paradise? The only argument against this conjecture was the coarseness of the work; the workmen, said sceptics, must be very unskilful above. The dispute was at this point when the journals, publishing an account of Gay-Lussac's voyage, put an end to it, and classed among natural effects what had until then been regarded as a miracle."

At Milan Gay-Lussac and his fellow travellers found the scientific world much excited by the announcement of the pretended discovery of Configliachi that water was composed of muriatic acid and soda! On consulting Volta, the eminent electrician replied: "I have seen the experiment, but I do not believe in it." This dictum, Arago remarks, might occasionally find valuable application.

We are told that at the end of the eighteenth century no one was considered a real physicist unless possessing a valuable collection of instruments well polished, well varnished, and arranged in glass cases. It was not without trouble that Gay-Lussac, who owned only a few instruments of research, succeeded in overcoming this prejudice.

The delay of the French Government in creating him a peer meets with an amusing explanation. The "dispensers of royal favour" had no fault to find with his personal eminence, with his connections, or his character. "They acknowledged softly, very gently, shrouding themselves in mystery, as if ashamed of such an avowal, that the great chemist worked every morning with his own hands in the assay-office, which seemed incompatible with the dignity of a peer of France!" Had it been his lot, however, to have been born in England, even had he been far more eminent than he really was, such a thing as his elevation to the peerage would never even have been mooted. Gay-Lussac was several times wounded in the course of his researches. He was once nearly blinded, and on another occasion received an injury in the hand, which it is intimated ultimately led to the disease of which he died. His unfinished "Philosophie Chimique" he unfortunately ordered to be destroyed.

Pollen. By M. Pakenham Edgeworth, F.L.S., F.A.S. London: Hardwicke and Bogue.

The author mentions that two years ago Mr. Airey published some observations on the dust collected by exposing to the air plates of glass smeared with some glutinous substance, and mentioned that among this dust were grains of pollen. The author who had long ago examined and drawn a number of specimens resumed the subject, enquiring into the forms of pollen likely to be diffused in the air, and thence proceeding to discover all he could about pollen. He has thus produced a monograph utterly "unreadable," but at the same time exceedingly useful as a work of reference for botanists and for all who take an interest in the nature and properties of the microscopic solids suspended in the atmosphere. The bulk of the work is devoted to a catalogue of the plants whose pollen has been examined by the author or by his predecessors in the same field, and with references to the plates which contain 446 figures, all drawn to scale, so as to enable the student to ascertain the actual size of the specimen in every case. The bibliography of the subject is also given.

Among the general conclusions which the author deduces from his investigations we find it remarked that in some botanical families the species vary greatly in the shape and size of their pollen grains, whilst in others they are almost always the same. Hence, the value of a consideration of these grains in studying the affinities and position of a plant fluctuates greatly. In size the grains differ also widely. Some, as in the Malvaceæ, *Cobea*, and some species of *Iris*, being as much as 1-100th of an inch in diameter, and consequently visible to the naked eye. In many Primulaceæ, Melastomaceæ, Borragineæ, &c., they do not exceed 1/4 to 2-600ths of an inch. Their colour is mostly yellow or white, but the author has met with blue, red, brown, and even green pollen, a fact which Lindley has denied. In three or four instances only he has found two or three different forms of pollen produced by the same anther. In *Mimulus luteus* he has found the simple form common in the Scrophulariaceæ, mixed with a coiled form. The simplest form—that of a bag with one slit—is seen in the *Magnolia* and the *Nuphar*, the author here remarking, "it is curious that the simplest pollen should be found in one of the most ornate and largest of flowers.

CORRESPONDENCE.

AROMA OF BUTTER.

To the Editor of the Chemical News.

Sir,—An abstract from *Les Mondes* (Chemical News, vol. xxxvii., p. 31), in reference to the aroma of butter, mentions the use of *Asperula* and other herbs in the churn for the purpose of imparting the aroma of mountain growth. Permit me to remark on this that the flavour would be unpleasant to the public, whose taste has been otherwise trained; by carrot-juice, churning-salts (nitre), annotto, and other special nostrums.

I have observed that in many parts of Switzerland, noted for their good milk and superior butter, a simple and, I think, a valuable method of not only bestowing a fine aroma, but of removing any *gouty* or *sweaty* odour from the milk, is in regular use there. The milk, as soon as it is drawn and whilst warm, is filtered through a sprig of washed fir-tips, the stem inserted loosely and upright into the hole of a funnel. The milk being poured on this bunch of clean spicular leaves, deposits hairs, skins, clots, or gelatinous sliminess, as the case may be, on the little spikes. A fresh sprig is used at each milking. The milk that drains is clean, and especially of a fresh flavour, or so slightly aromatised as to retain no unpleasant resinous odour; but becoming as it were "cured," it does not turn sour as soon as milk strained through wire-gauze. Horse-hair strainers are difficult to keep sweet; they often propagate decay by the film of animal matter which they retain, especially close to the joints of the wood. No insects are ever found in fir-tips, whilst *Asperula* and many other herbs occasionally abound in them, and they cannot be used in winter except in the dry state, when their odours are mostly gone. The fir-tips are rinsed only to remove dust; they are obtainable fresh even during winter, as the fir is an evergreen.—I am, &c.,

F. Trachsel.

Church, near Accrington, Jan. 19, 1878.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—The objection which I and other chemists have to the Institute is that it is not calculated to do any appreciable good, either to the public or to the general body of chemists; more than that, under its present auspices it bids fair to become a very sinister organisation, and, with the experience of fifteen years of professional life in London, I warn the younger members of my profession to hold aloof from the Institute.

If corporate action among English chemists can effect anything good, it can reform the Chemical Society; and until that Society has been put into a reputable condition all efforts at organisation must prove abortive.

From Mr. Groves's letter of December 21st, 1877 (Chem. News, vol. xxxvi., p. 274), it appears that more than three hundred persons had been elected Fellows of the Institute. As this statement was evidently made to induce others to join, it ought to have been coupled with information as to how many had accepted the election. Within my own knowledge several chemists have declined.—I am, &c.,

J. Alfred Wanklyn.

January 28, 1878.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Many chemists will, doubtless, in the main, agree with the remarks of your correspondent "Well-wisher" on the new Institute. I cannot but think, however, that his strictures upon those who have not received that "training" he himself has been sufficiently fortunate to enjoy are somewhat too severe. "Unqualified humbugs," "bottle-washers," and "druggists who undertake to do analytical work in the intervals of making pills and lotions," are uncharitable and uncalled-for expressions. "Well-wisher" must have forgotten that history records more than a solitary instance of a man who has raised himself to the very highest rank in science, but who, nevertheless, started life as one of those "druggists" he so contemptuously alludes to. Cannot "Well-wisher" call to mind many men of science amongst us who are also engaged in trading pursuits? Moreover, is it not a fact that in the Council mentioned by Mr. Groves there occurs the name of at least one who is a "druggist," and a West-End *pharmacist*, as the modern expression has it, and who, it is said, has been actively engaged in developing the "Institute," but whose original contributions to science have *not* been, so far as I know, of a startling character? For aught I know there may be more than one of this very Council who commenced their career as "druggists," and received their early training "in the intervals of making pills and lotions"—if so, it is much to their credit. Certainly the "druggists" are not badly represented, as there are several gentlemen on the Council very closely connected with the trade.

But those chemists who think and feel with "Well-wisher" can hardly be expected to accept the courteous invitation of the Council, through Mr. Groves, to send certificates and details of training to a Council so composed. In common with many others I very much regret that so much needless secrecy has been observed in the promotion of the "Institute," and still further regret that the originators should have given way to so much narrow-mindedness and apparent "cliqueism" as the secret election of three hundred members betrays.

In my opinion every man, whether he be "druggist," "bottle-washer," or tinker, who can show by his *published original work*—not by certificate, and so forth—that he is worthy of the distinction ought to have the right to join the Institute, and of companionship with his scientific brethren. Until this is acknowledged, and acted upon openly and without favour, the Institute cannot hope to take deep root, or acquire the vigorous growth necessary to a permanent institution.—I am, &c.,

Justitia.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 26, December 24, 1877.

Indices of the Ordinary and Extraordinary Refraction of Quartz for Rays of different Wave-lengths as far as the extreme Ultra-Violet.—E. Sarasin.—The author states that the extreme ultra-violet spectra can scarcely be studied without apparatus fitted with prisms and lenses of quartz, since it is transparent for all radiations, even the most refrangible hitherto observed, whilst the different kinds of glass absorb the greatest part of these radiations, and even Iceland spar is not absolutely transparent for the extreme rays. A knowledge of the indices of refraction of quartz for these different radiations is therefore an essential element in the study of the ultra-violet spectra. He has therefore prepared a table of the indices of refraction of quartz, both for the ordinary and extraordinary ray.

Engraving on Glass by means of Electricity.—G. Planté.—The surface of a plate of glass is covered with a concentrated solution of potassium nitrate. Into the fluid layer thus covering the glass is plunged a horizontal platinum wire, running along the edges of the plate, and communicating with the pole of a secondary battery of 50 to 60 elements. The other electrode—formed also of a platinum wire, surrounded, except at its point, with a non-conducting substance—is taken in the hand, and with its point characters or designs are traced on the glass. A stronger current is required to engrave with the negative electrode.

Gazzetta Chimica Italiana. Fasc. x., 1877.

Dilatation of Fused Sulphur.—Dr. S. Scichilone.—The results obtained by Prof. Pisati not agreeing exactly with those of Montessier, the author examines if this discrepancy is due to the condition of the sulphur. He finds that sulphur precipitated from sodic hyposulphite, and purified by repeated crystallisations from bisulphide of carbon, behaves exactly like natural sulphur. On carrying the heating up to 440° he found, for the coefficient of dilatation, values substantially identical with those of Montessier.

On the Molybdenite of Biellese.—A. Cossa.—The author found, on analysis,—

Molybdenum	58·23	59·05
Sulphur	41·36	41·17
	99·59	100·22

The mean specific gravity of the mineral is 4·704.

An Experiment on Betulin.—E. Paterno and P. Spica.—The authors, on distilling betulin with anhydrous phosphoric acid, obtained an oily liquid, boiling between 245° and 250°, and having the composition—

Carbon	89·23
Hydrogen	10·74
	99·97

Ammoniacal Derivatives of Chloral.—R. Schiff and

G. Tassinari.—The authors examine the action of anhydrous acetic acid and butyl-chloral ammonium, of acetamid and butyl-chloral ammonium, of benzamid and butyl-chloral ammonium, of urea and butyl-chloral ammonium, of acetamid and bromal ammonium, and of the aldehyds upon chloral ammonium.

Maturation of Grapes gathered before Ripeness.—E. Pollacci.—The author finds that grapes plucked when unripe continue to mature as the proportion of sugar gradually increases, while that of acid diminishes.

Contribution to the Study of the Tannin contained in Ilex Paraguayensis.—P. N. Arata.—A detailed comparison of the behaviour of the tannin of "Maté," or Paraguay tea, with caffeo-tannic acid.

Moniteur Scientifique Quesneville.
January, 1878.

Process for Determining the Vapour-Density of Bodies Boiling at Elevated Temperatures.—Victor Meyer.—Taken from the *Berichte der Deut. Chem. Gesell.*, ix., 1216.

Cyclamin, Primulin, and Primula-camphor.—Dr. Mutschler.—From *Liebig's Annalen*, February, 1877.

Hydrogenisation of Benzol and of the Aromatic Compounds (M. Berthelot's Recent Researches).—E. Noelting.—The author remarks that according to the formula of Kekulé in the bisubstituted derivatives, only three isomers are possible, whilst according to that of Berthelot there should be four. He does not, however, undertake to decide.

Azoic Colouring Matters.—E. Noelting.—A brief sketch of the history of this class of dyes, from Bismarck brown to chrysoidin.

History of Rosolic Acid, and on its Relations with Rosaniline.—R. von Wagner.—There is reason to believe that this acid derivative of phenol will one day form, as well as aniline, a point of departure for the manufacture of rosaniline and its derivatives. It is therefore important to know what is the actual state of our acquaintance with this acid. In 1833 Runge, in his classical researches on the principles contained in the oils of coal-tar, discovered three bases (cyanol, pyrrol, and leukol), and three acids (the carbolic, brunolic, and rosolic. Reichenbach contested the novelty of the discovery, and maintained that he had years ago isolated from the oils of beech-tar several of the bodies which Runge had now obtained from coal-tar. The first authorities of the epoch—Liebig, Poggendorf, and Mitscherlich—confirmed, however, the existence of the six bodies discovered by Runge. This controversy showed the characteristic distinction between the principles obtained respectively from wood-tar and coal-tar, and proved, further, that the base described by Runge as cyanol had been first obtained in 1826 by Unverdorben. Runge did not understand the relation existing between phenol and rosolic acid. He obtained it by boiling in water the residue from the distillation of carbolic acid, and adding acetic acid to the rose-coloured solution derived from the rosolate of lime formed. He also observed that rosolic acid was a true colouring principle, forming with certain mordants red colours and lakes of a beauty comparable to those of carthamin, cochineal, and madder. After describing the results—often conflicting—of the chemists who have since occupied themselves with rosolic acid, the author refers to the researches of Dale and Schorlemmer, who find that rosolic acid may be converted into rosaniline by the action of liquid ammonia at a temperature of 200°.

Modes of Formation of Acids in the Organism, and on certain properties of the Serum of the Blood.—Prof. R. Maly, of Gratz.—A lengthy treatise, taken from he *Sitzungs berichte* of the Imperial Academy of Sciences of Vienna for 1877. The author announces that hydrochloric acid is liberated by the reaction of the acid monobasic phosphate of soda upon the chlorides.

Nitrification by Organised Ferments.—MM. Th. Schlœsing and A. Muntz.—According to the experiments of the authors, whenever a nitrifiable medium is kept in presence of chloroform or heated to 100°, and then preserved from contact with atmospheric dust, nitrification is suspended, but it may be set up again by introducing a trace of earth in the act of nitrification.

Artificial Production of Corundum, Ruby, and of the various Crystalline Silicates.—MM. Fremy and Feil.—Already noticed.

Bulletin de la Societe Chimique de Paris,
No. 1, January 5, 1877.

Certain Melting-points.—M. Berthelot.—The author finds that crystalline phosphoric acid, PO_8H_3, melts at 41·75°, and re-solidifies at 40·5°. The slightest trace of an excess of water lowers the melting-point. Monohydrated nitric acid melts at −47°, and chloroform at −70°. Carbonic acid boils about −78·2°.

Heat of Neutralisation of Perchloric Acid.—M. Berthelot.—At 15° 100·5 grms. of diluted ClO_8H + 76·5 grms. of dilute BaO liberate +13·8.

Action of an Alcoholic Solution of Potassa upon Chloroform.—M. Berthelot.—The author had hoped to use the decomposition occasioned by this reaction for measuring the heat of the formation of chloroform from its elements, but found this impracticable, owing to the complications so frequent in organic reactions.

Liquid contained in a Very Ancient Glass Vase.—M. Berthelot.—A very lengthy notice of a liquid contained in a nodule in the stem of an ancient vase. On analysis it proved to be water which had dissolved small quantities of the constituents of the glass.

Remarks on M. Plicque's Note on Artificial Ultramarine.—E. Guimet.—The author asserts that M. Morel was the first to suggest and to make a selenium-ultramarine. He also declares that M. Plicque experimented, not partially, but solely at his expense.

Direct Manufacture of Soda and Potassa from their Chlorides.—G. Bohlig.—The author digests oxalate of magnesia with an equivalent of the alkaline chloride and hydrochloric acid, according to the equation—

$$C_2O_4Mg + HCl + NaCl = C_2O_4HNa + MgCl_2.$$

Magnesium chloride remains in solution, whilst acid sodium oxalate separates in crystals. These are washed in a little water, and introduced into an autoclave with a corresponding quantity of magnesian carbonate and water. Carbonic acid is at first disengaged: when it has expelled the air the autoclave is shut, and the mass worked up with an agitator. The pressure rises at first to two atmospheres, falling again to nothing. The products of the reaction then consist in a strong solution of sodium bicarbonate and magnesian oxalate, compact and crystalline. The solution of bicarbonate is boiled with magnesia (obtained by the decomposition of magnesium chloride by heat), when carbonate of magnesia is precipitated, and neutral carbonate of soda remains in solution.

Reimann's Färber Zeitung,
No. 47, 1877.

This issue contains nothing of general interest.

Sewage Treatment.—At the last meeting of the Aylesbury Local Board of Health it was unanimously resolved—"That the Board are perfectly satisfied with the manner in which the Sewage of the District has been treated by the Native Guano Company."

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

DECEMBER, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·000	0·008	0·120	0·134	19·20	7·450	0·500	0·37	1·730	12·6	3·70
West Middlesex	Clear	0·001	0·008	0·135	0·083	19·80	7·950	0·500	0·87	1·460	13·2	4·20
Southwark and Vauxhall	Clear	0·001	0·009	0·135	0·127	18·70	7·610	0·500	0·87	1·700	12·1	4·20
Chelsea	Clear	0·001	0·010	0·135	0·068	18·90	7·950	0·390	0·87	1·260	12·6	3·30
Lambeth	Clear	0·001	0·009	0·120	0·083	20·30	8·560	0·460	0·94	1·660	13·7	3·70
Other Companies.												
Kent	Clear	0·000	0·003	0·310	0·003	27·90	11·640	0·720	1·37	2·660	18·6	6·00
New River	Clear	0·000	0·007	0·150	0·036	20·20	9·070	0·360	0·87	0·930	14·3	3·30
East London	Clear	0·001	0·007	0·096	0·036	14·90	5·600	0·430	1·94	1·400	9·0	3·70

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B

NOTES AND QUERIES.

Manilla Rope.—Can any of your readers inform me of a mixture, used in the manufacture of Manilla rope, which will not evaporate or injure the colour, quality, or pliability of the rope?—ENQUIRER.

MEETINGS FOR THE WEEK.

SATURDAY, 2nd.—Physical, 3. "On Grove's Gas Battery," H. F. Morley, M.A., B.Sc. Annual General Meeting.
MONDAY, 4th.—Medical, 8.
—— London Institution, 5.
—— Royal Institution, 2. General Monthly Meeting.
—— Society of Arts, 8. "Explosions in Coal Mines," by Thomas Wills, F.C.S.
TUESDAY 5th.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
WEDNESDAY, 6th.—Society of Arts, 8. "Higher Commercial Education," John Yeats, LL.D.
—— Geological, 8.
—— Microscopical, 8. (Anniversary).
—— Pharmaceutical, 8.30.
THURSDAY, 7th.—Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
—— Chemical, 8. "Notes on the Tannins," Dr. Paul and Mr. Kingzett. "On a Method for the Determination of Boiling-Points," H. C. Jones. "The Alkaloids of the Aconite Family," Dr. Wright and Mr. Luff. "An Inquiry into the action of the Copper-zinc Couple on Alkaline Oxysalts," Dr. Gladstone and Mr. Tribe. "On the Estimation of Phosphorus in Iron and Steel," E. Riley.
FRIDAY 8th.—Royal Institution, 9. Weekly Meeting. "On Equality," Mr. Matthew Arnold.
—— Quekett Club, 8.
SATURDAY, 9th.—Royal Institution, 3. "Carthage and the Carthaginians," R. Bosworth Smith, M.A.

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WATER ANALYSIS.—Prof. WANKLYN, Lecturer on Chemistry and Physics at St. George's Hospital, Public Analyst for Buckinghamshire, Buckingham, High Wycombe, Peterborough, and Shrewsbury, has REMOVED to 7 Westminster Chambers, Victoria Street, S.W

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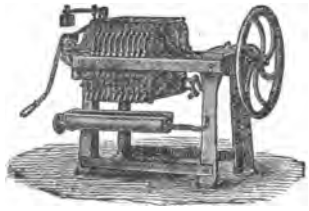

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THE CHEMICAL NEWS.

Vol. XXXVII. No. 950.

ON DYER'S CHEMICALS.

By J. MARZELL.

(Continued from p. 45.)

Dinitro-Benzol.

As crude material for this purpose either mono-nitro-benzol is taken, or it is started from benzol directly, without taking any notice of the intermediate formation of the mono-nitro-product. Following the first way, the usual process is to let mono-nitro-benzol slowly run into a mixture of nitric and sulphuric acid, and to purify the resulting product by washing and pressing.

But there are many reasons against this method in industry. The manufacture of mono-nitro-benzol as independent product requires treatments which can be neglected, the working up to dinitro-benzol being intended, *e.g.*, the washing out of the surplus acid, the distilling, &c. Therefore, in industry, benzol is by preference taken as a starting-point, treated with the mixture of acids in the same way as usual with the nitro-benzol, only the reaction is continued until the two NO_2 groups are substituted.

Referring to the mixture of acids, the opinions about the proportions between nitric and sulphuric acid are different. For laboratory works, equal portions are considered sufficient; but in working on a large scale a surplus of sulphuric acid is to be preferred. If we remember that in fact only the nitric acid is the reacting agent, whilst the sulphuric acid only acts by its hygroscopic qualities, that is to say, by absorbing the water delivered in the reaction it prevents the weakening of the nitric acid. Therefore, it is better, at all events, to take a little too much sulphuric acid than to run the risk of diminishing the yield and wasting the material. A proportion found as answering all practical purposes in working on a large scale would be—

100 NO_3H of 1·425 specific gravity.
150 H_2SO_4 of 1·843 „ „

About the proportions between benzol and acids a small experiment will show that approximately. To a certain quantity of mixture of acids benzol from a known lot is added as long as it dissolves. In the end a little warming up will be of advantage. By comparing the remaining benzol, &c., a certain proportion will be given.

In the praxis the following proportions have proved to be practical:*—

100 parts benzol.
100 lbs. NO_3H of 1·425 sp. gr.
156 lbs. H_2SO_4 of 1·843 „

256 acid mixture.

The apparatus are the same as used in manufacturing mono-nitro-benzol, only they are plunged into an oil-bath. The benzol is put in, and the acid mixture admitted slowly, whilst the agitator is moving, and the refrigerator in work in the same way as with mono-nitro-benzol. If the first violent action is over, the agitator is stopped, and the mass allowed to settle. The weak acid is drawn off, and after that the operation taken up again with a fresh portion of acid. This time the liquors mix very easily, and the temperature just rises enough to keep the reaction going. If necessary a slight heat is applied. The operation may be considered finished if a sample of the oil swimming on the surface being taken solidifies in cooling. The dinitro-benzol is drawn off whilst it is hot and fluid, then it is washed, at first with hot, and then with cold water, and finally pressed.

The reactions taking place in the operation may be represented with the following figures:—

I. $C_6H_6 + NO_2OH = C_6H_5NO_2 + H_2O$.
II. $C_6H_5NO_2 + NO_2OH = C_6H_4(NO_2)_2 + H_2O$.

In this manner a dinitro-benzol is obtained of boiling-point 86° C.

β-Phenylen-diamine, $C_6H_4\{^{NH_2}_{NH_2}$.

This base was discovered in 1844 by Zinin,* who got it by the entire reduction of dinitro-benzol of b.p. 86° C., and characterised by A. W. Hofmann† in 1862.

The methods of producing it are various. The first and most important is that of Zinin's. Gerdemann‡ describes it thoroughly.

I. $C_6H_4\{^{NO_2}_{NO_2} + 6H = C_6H_4\{^{NH_2}_{NO_2} + 2H_2O$.

II. $C_6H_4\{^{NH_2}_{NO_2} + 6H = C_6H_4\{^{NH_2}_{NH_2} + 2H_2O$.

Mills got it by reducing the β-nitraniline with hydriodic acid. (This nitraniline appears in the first method as intermediate product.)

According to Martius and Griess‖ it is formed by acting upon amido-azo-benzol with reducing agent. Sn and HCl convert the amido-azo-benzol into aniline and β-phenylen-diamine of f.p. 63° C.

$$C_6H_5N=N-C_6H_4(NH_2)+2H_2 = C_6H_5NH_2 + C_6H_4\{^{NH_2}_{NH_2}$$

Th. Zincke and F. Sintenis§ treat the brom-dinitro-benzol, of temperature 72° C., with Sn and HCl. The two NO_2 groups are reduced, and the bromine atom is taken away.

$$C_6H_3\{^{NO_2}_{Br}_{NO_2} + 7H_2 = C_6H_4(NH_2)_2 + HBr + 7H_2O.$$

On the large scale only the first method has been adopted, and as reducing matters tin and hydrochloric acid are taken by preference (Gerdemann).

Manufacturing.

Into a mixture of 1 dinitro-benzol and 12 metallic Sn hydrochloric acid is added slowly, and in a fine stream. The reaction is a very violent one. In cooling crystals separate of chloro-stannite, $C_6H_8N_2(HCl)_2 + Sn_2Cl_4$, in white needles. This double salt treated with sulphuretted hydrogen yields the hydrochlorate of the phenylen-diamine, which is precipitated of its aqueous solution by a surplus of HCl. On decomposing this HCl salt with any alkali the free base is obtained. To recover the Sn,¶ throwing down with Zn is the best way. Sn is taken to produce the reduction, but it is precipitated as soon as it goes into solution. This is attained by means of adding Zn, as long as the reaction takes place resp. is going on.

The β-phenylen-diamine represents a di-acid base. The salts are crystallisable and soluble in water. Alkalies precipitate the base in an oily modification. In excess of ammonia it is dissolved with a brown colour, decomposition taking place. The base itself forms white crystals, however, getting brown in contact with the air. It crystallises very slowly, and if distilled it remains a long time liquid. The fusing-point is at 63° C., and the boiling-

* Wurtz, Matières Colorantes.

* *Journ f. Prakt. Chemie*, xxxiii., 34.
† *Proc. Roy. Soc.*, xi., 518.
‡ *Zeit. f. Analyt. Chemie*, 1865, 51.
‖ *Bull. de la Soc. Chim.*, vi., 158.
§ *Berichte der Deut. Chem.*, v., 796. *Bull. de la Soc. Chim.*, 1872, xviii, 549.
¶ Wurtz, Matières Colorantes.

point at 287° C. (Hofmann; at 276° to 277°, uncorrected, Zincke). It is only very slightly soluble in water, better in alcohol and ether. According to A. W. Hofmann it is not advisable to take $(NH_4)_2S$, as that salt decomposes the phenylen-diamine, partially forming a brown mass.

(To be continued).

PRELIMINARY NOTICE OF A NEW YELLOW COLOURING MATTER.

By RAPHAEL MELDOLA.

Diphenylamine is dissolved in from six to seven times its weight of glacial acetic acid, and a stream of nitrogen trioxide passed through the cooled solution for some hours. A yellow crystalline substance separates out, which is filtered off, and washed with cold water till free from acid. This substance, when boiled with an alcoholic solution of sodic hydrate, is decomposed with the formation of a deep red solution, and on pouring into water, a substance of a fine yellow colour separates out in minute crystals. The new colouring matter thus obtained is insoluble in water, soluble in benzene, petroleum, and alcohol. It dyes silk and wool of a most brilliant yellow colour, and is unaffected by either acids or alkalies. A scientific examination into the nature of the compounds produced in these reactions is now in progress.

Atlas Works, Hackney Wick, London, E.,
January 31, 1878.

ON THE

MANUFACTURE OF IODINE, BROMINE, AND NITRATE OF POTASH TOGETHER WITH SODA BY THE AMMONIA PROCESS.

By THORWALD SCHMIDT, Aalborg, Denmark.

There has of late been addressed to me from various places inquiries and requests for particular information, as to the method of the combined manufacture of the above products, probably because Mr. E. C. C. Stanford, Glasgow, in the Chemical News, April, 1877, in his treatise on the manufacture of iodine, touches on this combined process. I therefore willingly give an explicit representation of the details.

The ashes of the seaweed—kelp—are washed according to the method given by Shanks, St. Helens, near Liverpool, for which purpose is used a series of large square vessels, over whose real bottom is applied another double bottom furnished with holes. From the space between the real bottom and the one with holes a pipe leads into the upper part of the next vessel; from the bottom of the latter a pipe like the former leads into the next, and so on. In this manner the fresh water always meets the most washed ashes, and the fresh ashes the strongest solution. The exhausted ashes may be used as excellent manure, or may still more profitably be sold in places where the phosphoric acid therein contained may in any other manner be of use.

The solution having been concentrated as much as possible, is to be tapped into a reservoir large enough to hold the quantity of liquor containing chloride of calcium sufficient to transform the sulphates contained in the solution into hydrated sulphate of lime and chloride combinations.

The liquor of chloride of calcium is to be had in large quantities as a refuse from the manufacture of ammonia-soda. At first we must ascertain how much chloride of calcium is requisite, and then it is added gradually under continual stirring, until no more sulphate of lime precipitates; but of course no more chloride of calcium must be added than is strictly needful.

When the liquor, after a careful mixing, is left to itself, the greatest part of the sulphate of lime will soon deposit on the bottom of the vessel, but a part of it finely divided will still continue to float in the liquor whilst another part of it dissolves in it.

A small distance above the bottom of the vesse is attached a pipe in connection with a suction and forcing pump; when the liquor has become tolerably clear, the pump is worked, and the fluid is forced through a filter-press into a similar reservoir. The fluid is now quite clear, and of the sulphuric salts only the dissolved sulphate of lime remains.

Now we take a sample of the solution, test how much of the chloride of barium is needed to precipitate the sulphuric acid in the dissolved sulphate of lime, as sulphate of baryta, weigh the necessary quantity of chloride of barium, and dissolve it in as much of the solution as needful. The latter solution is poured into the vessel, and the liquid is well stirred, that the mixture may be as complete as possible.

Another pump, likewise with a pipe in connection with this reservoir, again presses the liquid through a second filter-press into the third reservoir.

When a large quantity of sediment of sulphate of lime is gathered in the first reservoir, the latter is cleared, and this sulphate of lime, as well as that from the filter-cloths, is to be well washed, and the washing is used again for dissolving the kelp.

We have of course now—

Precipitated sulphate of lime=*Annaline*, or pearl-hardening;

Precipitated sulphate of barytes=*Blanc fix*, or permanent white; and all the sulphates in the fluid transformed into chlorides.

We now examine how much of iodine and bromine is contained in this clear liquid, and put so much nitrate of lead to it that we are sure of a small surplus, so that a little chloride of lead may be precipitated. The liquid is to be stirred well, that a careful and intimate mixture may take place, and this stirring is to be continued until the lead solution is all poured in.

As soon as we are sure of a complete mixture, the pump which is in connection with this vessel is worked, and the liquid is, as in the foregoing operation, forced through a third filter-press into a fourth reservoir. We have then, when the vessel is employed, all the iodine and bromine with a little portion of chloride, as iodide, bromide, and chloride of lead on the filter-cloth. In this manner all loss of iodine and bromine is prevented, which in the manner generally adopted can only be attained through careful and repeated washings, and a considerable quantity of fuel and time is saved. The iodide and bromide of lead is then worked into such combinations as are required.

The liquor from this operation contains, as may be understood, besides the trifling quantity of nitrate from the nitrate of lead, all the potash, soda, magnesia, and lime combinations as chlorides. To this is put some dirty carbonate of soda, such as sweepings from the soda works, to precipitate the magnesia and the lime. Having stirred the liquid in the vessel for some time, we again let the liquor, by means of a pump, pass a filter-press, and in this liquor we dissolve as much nitrate of silver as is needful to transform the remaining potash into nitrate of potash, after which it is treated in the manner generally used in manufacturing of nitrate of potash. Still, it is advisable to apply the filter-press before the beginning of the evaporation.

The salts left as a refuse by this mode of manufacture are excellent materials for the manufacture of soda by the ammonia process, which has been proved long ago by practice, and it is, therefore, after the experience I have had, my firm conviction that these industries are in a high degree adapted to be combined. Either we wish to carry

on the whole combined business, or only the manufacture of soda and nitrate of potash, so much the more as we may work proportionately as profitable in a small as in a large manufactory of soda, of course within certain limits. We are of opinion that such a manufactory must not produce less than 20 or 30 cwts. of soda per day, and the furnishing will, besides the cost of buildings and boilers, amount to about £1600.

In beginning such an enterprise on a smaller scale we have the advantage with proportional small means, to be able to surmount the technical difficulties, exercise the workmen, arrange the circumstances connected with the sale, and are always able to extend the works.

Where seaweed is to be had in large quantities on the coast, or where there is already a manufactory of nitrate of potash, or where rocksalt or salt wells are near, and coals and limestone may be had tolerably cheap, there a manufactory of ammonia-soda will be carried on with profit.

For further explanation I shall only add that 180 to 200 parts of salt, 105 parts of good coal, 5 parts of sulphate of ammonia, 23 parts of coke, 1 part of sulphuric acid, and 80 parts of limestone are the raw materials for 100 parts of refined soda, 95-97 per cent. equal to about 270 parts of crystal soda. I shall willingly—if such is wanted—give the details of such an establishment.

The manufacturing itself of ammonia-soda is, with appropriate apparatus, by no means more difficult than any other mere chemical manufacturing business; and it has this good point, that no persons will easily understand what takes place, unless they are intimately connected with it, or the operation of the apparatus is explained to them, nor can the workmen give any particular information; it is thus possible, with a little care, to keep this interesting manufacture a secret to the public for a long time.

PROCEEDINGS OF SOCIETIES.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

The first General Meeting of this Institute was held on the 1st inst. at the Rooms of the Chemical Society, Burlington House. Dr. Frankland, F.R.S., President, in the chair.

In an able address the President reviewed the development of practical and professional chemistry in this country, the present status of trained and educated chemists, and the sequence of events and considerations which led to the formation and incorporation of the Institute. At the beginning of the year 1845 he (the President) could only hear of one laboratory in which to obtain instruction in chemical analysis. This laboratory was in the cellar of the Royal Institution in Manchester, and was under the direction of Dr. Lyon Playfair. About the same time the Royal College of Chemistry was opened by Dr. Hofmann. From it, and from one or two other laboratories subsequently established, there soon issued a veritable army of chemists who instituted practical instruction through the length and breadth of the land. Henceforth the opportunities of becoming practically acquainted with chemistry were greatly multiplied. It became an independent subject of instruction in Schools, Colleges, and Universities, and thus, in connection with the Science and Art Department alone, there were in the year 1876 no less than 115 chemical laboratories, in which 2400 pupils received individual practical instruction.

This rapid advance Dr. Frankland ascribed partly to the fascination of a study which brings the pupil continually into the closest contact with nature, and partly to the great increase in the number and importance of the applications of chemistry to agriculture, technology, public health, and the daily wants of modern civilisation. These intimate relations of applied chemistry to daily life have rendered necessary an organisation amongst chemists which should stand in the same relation to the profession of chemistry as that occupied by the Colleges of Surgeons and Physicians towards medicine, the Institute of Civil Engineers towards the profession of civil engineering, and the Inns of Court towards the practice of law. On the occasion of the Dinner in honour of Professor Canizzaro's visit to England as Faraday Lecturer in May, 1872, he (the President) had suggested such an organisation, but no attempt was made to originate such a scheme until April, 1876, when it was sought to accomplish the necessary objects in connection with the Chemical Society. Legal and other difficulties, however, prevented the carrying out of this scheme, and it was resolved to form an association independent of the Chemical Society.

The necessary memorandum and articles of association were then drawn up, and application for incorporation was made to the Board of Trade as "The Institute of Professional Chemists." From a correspondence which ensued with the Board of Trade the promoters of the Institute learned to their astonishment that in the eye of the law they were not chemists at all, either professional or otherwise.

It appears that on receiving the application for incorporation the Board of Trade communicated with the Privy Council, and the Privy Council asked the advice of the Pharmaceutical Society. The Council of this Society urged as an objection to the new scheme the fact that they had appointed a Board of Examiners, and that those who passed the major examination of the Society were registered as Pharmaceutical chemists, while those who passed the minor examination were registered as Chemists and Druggists. The Council therefore contended that a sufficient guarantee was already afforded to the public or the courts of law of the competency of persons called as experts in chemical science, and that simple means already existed by which persons having recourse to chemists can prove their training and fitness for the skilful performance of the work they undertake. The Council also objected to the term "Professional Chemists," urging that all persons who have studied and may practise the science of chemistry, whether as applied to pharmacy, agriculture, or any other special object, may claim to be professional chemists. The Board of Trade therefore wrote to the promoters of the Institute, requiring them to modify their scheme so as to meet the objections of the Pharmaceutical Society. The promoters accordingly changed "Professional Chemists" to "Chemistry" in the title of the proposed Institute, and resolved to insert the following words in the Memorandum of Association:—"That no Fellow or Associate be entitled to a certificate of his Fellowship or Associateship." The opposition of the Pharmaceutical Society was then formally withdrawn, but the Board of Trade afterwards requested that the following sub-section, describing one of the objects of association, should be struck out:—"To ensure that consulting chemists and analytical chemists are qualified by study and training for the proper discharge of the duties they undertake." On being asked to state the grounds upon which the omission of the paragraph was asked for, the following letter was sent by the Solicitor to the Board of Trade to Mr. Pettengill:—

"Board of Trade,
"(Railway Department),
"London, S.W., 2nd July, 1877.

"Sir,—With reference to your interview with me this afternoon relative to the omission of sub-section 6 of section 3 of the Draft Memorandum of Association of the proposed Institute of Chemistry, I am directed by the Board of Trade to inform you that in accordance with your wish I have communicated with counsel on the subject. I am now to inform you that the sub-section was struck out on two grounds:—

(1.) Because it appeared to point to the granting of certificates and to nothing else.

(2.) Because it appeared to cast a doubt on the fitness of the Pharmaceutical Society to perform their duties, inasmuch as it is the duty of the Pharmaceutical Society to see that consulting chemists are duly qualified, and the fitness of the Society to perform that duty has been recognised by the State, and this being so further *security* for the qualifications of chemists does not appear to be needed.

As regards the fear which you expressed that the omission of the sub-section might be fatal to the promotion of the Institute, I am to add that it appears to this Department to be at least doubtful whether the words "to ensure that consulting chemists and analytical chemists are duly qualified" are required for anything (other than the grant of certificates) which the promoters can not do under the remaining part of the Memorandum.—I am, Sir,

"Your obedient servant,

"Henry E. Calcraft.

"J. Pettengill, Esq.,
"32, Walbrook, E.C."

It was, remarked the President in his address, of no avail to explain to the Board of Trade that membership of the Institute of Chemistry would confer no right to keep a druggist's shop, or to interfere with trade in any way, and that the titles "Chemist and Druggist" and "Pharmaceutical Chemist" have always been exclusively applied to persons keeping shops for the sale of drugs; whereas the terms "Chemist," "Analytical Chemist," and "Professional Chemist" have always been applied to persons specially trained in the science of chemistry. In adhering to their views on this matter the officials of the Board of Trade no doubt took their stand upon an act of Parliament which declares that a chemist, however eminent in his profession, shall not, under a penalty of £5 for each offence, describe himself as such unless he be duly registered as a chemist and druggist or a pharmaceutical chemist. The President of the Chemical Society, for instance, could not, in a court of justice or elsewhere, use the designation by which he is known all over the civilised world without thus infringing the laws of his own country.

While through the instrumentality of its excellent laboratory and its prescribed course of general education the Pharmaceutical Society has greatly raised the status of the druggist, and has conferred dignity upon a most important occupation, which, before the incorporation of the Society, was too often carried on by grocers, oilmen, and others entirely ignorant of the properties of drugs, Dr. Frankland thought the Society overstepped the limits of strict justice when, in 1868, it laid exclusive claim to a title which is the common property of all who cultivate the science of chemistry.

After receiving the above letter the promotion of the Institute had to choose either the acceptance of the condition of registration imposed by the Board of Trade or the establishment of the Institute as a private society. They decided upon the former alternative, and agreed to the removal of the sub-section, provided the next following sub-section were made to read as follows:—

"To adopt such measures as may be necessary for the advancement of the profession of chemistry, and particularly for the maintenance of the profession of the consulting and analytical chemist on a sound and satisfactory basis."

According to these amended statements of the Institute which were accepted by the Board of Trade still enable the Council to appoint and remunerate examiners, and to insist upon a high standard of qualification for admission to Associateship and Fellowship, such, for instance, as a sufficient preliminary general education and special training, the passing of satisfactory examinations in general chemistry, in the practical qualitative and quantitative analysis of minerals, organic compounds, and gases, in physics, and in mathematics, and a subsequent three years course of study and practical work in applied chemistry.

The President pointed out that these qualifications would serve to distinguish Fellowship of the Institute from Fellowship or Membership of any other body whatever in this country. The taking a medical degree requires only a very limited knowledge of theoretical chemistry, affords no testimony to the competency of the possessor to perform more than the very simplest operations of practical chemistry, and constitutes no guarantee that even an examinee in honours possesses that knowledge which is absolutely necessary for the efficient practice of professional chemistry; and the major examination of the Pharmaceutical Society, so far from justifying the opinion of the Solicitor to the Board of Trade, that "further security for the qualification of chemists does not appear to be needed," involves only the merest elementary knowledge of physics and arithmetic, and prescribes only the following practical knowledge of chemistry:—"The nature and properties of the elements and their compounds, both organic and inorganic, especially those used in Medicine or the Arts. Also the *qualitative* analysis of the more important chemicals—such as nitrates, chlorides, carbonates, sulphates, phosphates, oxalates, tartrates, &c.—and the detection of impurities in them, and the *volumetric* estimation of the *strength* of all Pharmacopœia preparations in which standard solutions are ordered to be used." So that this examination, which even stops short of every species of gravimetric quantitative analysis, tests only the simplest elements of that thorough knowledge which the Institute proposes to require of its candidates. Excellent as it is for testing the qualifications of a pharmaceutist, such an examination affords no test of the qualifications of those professional chemists who undertake the duties of Public Analysts,—or of giving advice in the applications of Chemistry to the Arts, Agriculture, and Public Health,—or of investigations in connection with the applications of Chemistry to Technical Industry. The President concluded his Address by paying a high tribute of praise to Mr. W. N. Hartley for the efficient manner in which he discharged the exceptionally heavy duties which fell upon him as an Honorary Secretary of the Institute up to the date of incorporation.

Dr. Odling, in proposing that the thanks of the Meeting be given to the President for his Address and that it be printed and circulated, took exception to that paragraph in the Address which spoke of Dr. Lyon Playfair's Laboratory as the first Laboratory of Practical Chemistry in England. A discussion ensued, during which it was mentioned that the late Dr. Graham's Laboratory was opened for practical teaching in 1840.

Dr. Attfield seconded the vote of thanks to the President, and referred to the establishment of, and the instruction given in, the Pharmaceutical Society's laboratory.

Mr. Riley and Dr. Tidy asked for information respecting the difference between a "Member" and a "Fellow" of the Institute.

Mr. Pettengill (the Solicitor) explained that the Fellowship had been introduced to meet the wishes of the promoters with regard to chemists residing abroad, and who were prevented from taking part in the affairs of the Association, but according to the Act under which the Institute was incorporated only "Members" were recognised.

A long discussion ensued, and it was ultimately decided that the Council should amend the articles so as more effectually to explain the meaning of the terms "Member" and "Fellow."

The Secretary read the following report:—

Report of Council.

The most important business which your Council has transacted since the incorporation of the Institute has necessarily been the development of the organisation by providing as far as possible for the admission of all compe-

tent chemists into the Association. In order to form a nucleus for the Institute it was deemed advisable in the first place to invite all those chemists of standing in the profession who were well known to members of Council, either personally or by repute, and with this object your Council at their first meeting—after formally electing as Fellows those members of the Organisation Committee who were not on the Council—instructed the Secretary to issue invitations to the most prominent members of the profession whose names had been selected by a committee appointed for that purpose, asking them to join the Institute. It is very likely, however, that the names of some few gentlemen were accidentally omitted from the list, although the Council has endeavoured to make it as complete as possible. A committee was then appointed to examine into the qualifications of candidates for admission to the Institute, not only of those who made personal application through the Secretary, but also of those who were proposed by Members of Council. At the same time advertisements were inserted in the *Times*, CHEMICAL NEWS, and *Nature*, announcing that the time for admission of original Fellows and Associates would expire on the 2nd of February, 1878. A large number of applications (over 150) were made asking for information as to the means of obtaining admission to the Institute, and of these 93 have already become candidates for the Fellowship or Associateship, and sent in formal applications accompanied by certificates. The Nominations Committee has carefully considered the qualifications of the several candidates, requiring as a rule that they should be those expressed in articles 56 and 60, namely, for Fellows—(1.) That he is not less than twenty-four years of age. (2.) That he has passed through a course of three years' training to the satisfaction of the Council in theoretical and analytical chemistry and physics, and has subsequently been engaged for three years either as assistant to a chemist of repute, or as a Professor or Demonstrator of Practical Chemistry at some known University, College, or Medical School, or as a chemist in a technical industry, or has, after three years' training as above, conducted and published an original research of sufficient merit, in the opinion of the Council, on some chemical subject necessitating practical work. Or, (3.) That he has been trained and occupied in other ways, which in the opinion of the Council are equivalent to fulfilling the conditions stated in the preceding article. For Associates—(1.) That he is not less than 21 years of age. (2.) That he has passed through a course of three years' study of theoretical and analytical chemistry, physics, and elementary mathematics satisfactorily to the Council. In very few instances only has the Council found it necessary to depart from this rule. Where candidates were not actually proposed by Members of Council they were required to produce certificates or other documentary evidence that their statements as to their training and subsequent chemical career were substantially correct. In the case of Associates, such was the satisfactory character of their training and experience that many of them might advance a valid claim to be admitted as Fellows if they were not disqualified by being under the age of twenty-four. All of them possess the qualifications specified in article 60—2, of having passed through a course of three years' study of theoretical and analytical chemistry, physics, and elementary mathematics. The objects of the Institute have been favourably regarded by almost all who have been invited to join, and even those who, from one cause or other, felt unable to take up the Fellowship have, with one or two exceptions, expressed sympathy with the objects of the Institute and wished it every success. Of the chemists invited to join at the first Council meeting 153 have already accepted the Fellowship. Since the first Council meeting 160 more Fellows and 43 Associates—proposed by Members of Council, or who have made personal application—have been elected, and of these 65 have accepted. As, however, only a short time has elapsed since the election of the greater number of these gentlemen no accurate estimate can be made of how many will eventually join, although, considering that nearly all have applied for admission to the Institute, either directly or through some Member of Council, in all probability there are but few of them who will not become either Fellows or Associates. At present, 225 Fellows have joined the Institute, and 87 have been elected, but yet not formally admitted. Your Council is of opinion that a high standard of education and training should be fixed as a necessary qualification for admission to the Associateship, not only in theoretical and practical chemistry, but also in the subsidiary subjects of physics and elementary mathematics, and that such a standard can only be maintained by a carefully arranged system of examinations. A committee has therefore been appointed for the purpose of drawing up a complete examination scheme, who will in a short time report to the Council on the best methods of obtaining these objects. The Council intend to publish, as early as possible, a complete list of the Fellows and Associates of the Institute. It is with the greatest pleasure that your Council announces that Dr. Frankland has offered two prizes of £50, each to be awarded by the Council of the Institute, and announced at the next General Annual Meeting, for the two best original investigations involving gas analysis, and conducted by Associates of the Institute. In conclusion, the Council desire to express their thanks to the President and Council of the Chemical Society for the use of their rooms on this and many previous occasions.

Mr. THORP proposed and Mr. RILEY seconded that the report be adopted.

The TREASURER then presented a Balance Sheet made up to December 31, 1877.

The meeting proceeded to elect by ballot four Censors. The Scrutators (Mr. Spiller and Mr. Newlands) announced that Dr. Warren de la Rue, F.R.S., Prof. Abel, F.R.S., Dr. Odling, F.R.S, and Dr. Roscoe, F.R.S., were duly elected.

The proceedings then terminated.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, February 4, 1878.

WARREN DE LA RUE, D.C.L., F.R.S., Vice-President in the Chair.

THE special thanks of the Members were given to Mr. William Bowman, F.R.S., M.R.I., for his present of an ivory bust of Professor Faraday, by the late Matthew Noble, M.R.I.

In reference to the Telephone, which Mr. Preece had explained to the Members on Friday last, the CHAIRMAN stated that he had made attempts to measure the current produced by the vibrations of the disk of iron in front of the magnet of the telephone, and that he was unable to detect any by means of a most sensitive dynamometer which would render evident the current of a Daniell's cell through 2000 ohms. Moreover, by other experiments made by other means, he concluded that the current produced did not amount to that which a Daniell's cell would send working through 100 millions ohm resistance.

PHYSICAL SOCIETY.

Annual General Meeting, February 2, 1878.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE PRESIDENT read the Report of the Council for the past year. After pointing with satisfaction to the present condition of the Society, the Report goes on to show how it is hoped to extend its usefulness in the future. In addition to a second edition of Prof. Everett's work on the "C.G.S. System of units," the Council hopes very shortly

to publish Sir Charles Wheatstone's papers in a collected form, and it is making arrangements for the publication, at intervals, of translations of foreign scientific papers, especially such as have had a marked effect on the progress of physical science. A portion of the funds of the Society is to be devoted annually to the formation of a library, and an exchange of publications is already made with various learned societies abroad. Special stress was laid on the distinctive object held in view at the formation of the Society, namely the exhibition, when practicable, of the experiments referred to in papers read at the meetings.

The following Officers and Council were elected for the ensuing year:—

President—Prof. W. G. Adams, M.A., F.R.S.

Vice-Presidents (who have filled the office of President)—Dr. J. H. Gladstone, F.R.S., and Prof. G. C. Foster, F.R.S.

Vice-Presidents—Prof. R. B. Clifton, M.A., F.R.S.; W. Spottiswoode, LL.D., F.R.S.; W. H. Stone, M.B., F.R.C.P.; Sir W. Thomson, LL.D., F.R.S.

Secretaries—A. W. Reinold, M.A.; W. Chandler Roberts, F.R.S.

Treasurer—Dr. E. Atkinson.

Demonstrator—Prof. F. Guthrie, Ph.D., F.R.S.

Other Members of the Council—Capt. W. de W. Abney, R.E., F.R.S.; Prof. W. F. Barrett, F.R.S.E.; Major E. R. Festing, R.E.; W. Huggins, D.C.L., F.R.S.; Prof. A. B. W. Kennedy, C.E.; O. J. Lodge, D.Sc.; Prof. H. M. McLeod; The Earl of Rosse, D.C.L., F.R.S.; Prof. W. C. Unwin, B.Sc.; R. Wormell, D.Sc.

Prof. H. L. F. Helmholtz and Prof. W. E. Weber were elected Honorary Members of the Society.

After votes of thanks had been passed to the Lords of the Committee of Council on Education for the use of the Physical Lecture Room at South Kensington, as well as for the other advantages enjoyed by the Society, and to the several Officers of the Society, the meeting was resolved into an ordinary one.

The following candidates were elected members of the Society:—M. T. Cormack; C. J. Faulkner, M.A.; E. M. Jones, F.R.AS.; C. Leudesdorf, M.A.; and C. E. Walduck.

Prof. S. P. Thompson exhibited an experiment in illustration of Ampère's law of parallel votaic currents. A plate of glass is perforated by two holes close together, which are traversed by one and the same wire, and this may be so arranged that the current traverses the parallel lengths in the same or opposite directions. If now the plate be held horizontally while the current passes, and fine iron filings be sprinkled on the plate, they will arrange themselves in the well-known forms. In the plates exhibited the filings had been fixed by gum so that their arrangement could be exhibited to an audience by projection on a screen.

EDINBURGH UNIVERSITY CHEMICAL SOCIETY.

Fourth Meetimg, January 30, 1878.

Mr. Newton Burns in the Chair.

Papers were read by Mr. G. Carr Robinson, F.R.S.E., on the "Solid Fatty Acids in Cocoa-nut Oil;" and by Mr. Thomson, "On the Composition of the Gases from Lime-kilns."

NOTICES OF BOOKS.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. lxxvi., July to December, 1877. London: Simpkin and Marshall.

This volume, as usual, contains a useful summary of the progress of medical science during the past half year, though there is little to interest the scientific chemist.

We are particularly struck with the sanitary, or rather unsanitary, condition of China, where filth of all kinds reeks over land and water, and yet the consequences we should naturally expect do not follow. "There is no typhus, no typhoid or other disease considered the inevitable consequence of defective sanitation, although Amoy and indeed all Chinese towns are full of typical fever-dens. No case has been met with, in either Amoy or Formosa, of scarlet fever, measles, relapsing fever, or diphtheria." Ague, cholera, and small-pox, however, abound. There are depths in the philosophy of zymotic disease to which we have not yet penetrated. The Chinese, it is remarked, never drink water which has not been previously boiled, and have no drains carried under their houses.

Eighth Annual Report of the State Board of Health of Massachusetts. January, 1877. Boston: A. J. Wright.

This volume comprises a number of essays and reports, of greater or less value, dealing with sanitary questions. The paper on the "Pollution of Streams" is characterised by a strong tendency to view facts through irrigationist spectacles. The Lawson case, where the "germs" of typhoid fever were found to pass through nearly a mile of gravel, if it proves anything at all, shows that the effluents from irrigation farms are not necessarily freed from any infectious matter which may have found its way into the sewage.

The reports on the "Registration of Disease," on the "Growth of Children," and on "Disease of the Mind," are of much higher value. In the last of these three essays the writer seems to doubt the influence commonly ascribed to heredity—a very satisfactory doctrine if thoroughly borne out by facts. He concludes with the following passage:—"Even as late as the time of the Ptolemies the plague was unknown in Egypt. One hundred years ago it was thought a necessary part of modern civilisation, and now, under a still higher civilisation, the area over which it is to be feared is narrowing from year to year. A similar result may be fairly expected with regard to diseases of the mind."

Unfortunately, except we are grievously misinformed, the plague is of late years extending its ravages, and the possibility of its re-appearance in Europe is now contemplated not without anxiety. Till modern civilisation can be freed from the anxiety and "worry" which are its greatest blots, we can scarcely expect a decrease in mental disease. The movement in England is at present in the opposite direction.

Medizinische Jahrbücher heraus gegeben von der K. K. Gesellschaft der Aerzte. Jahrgang 1877, Heft iv. Vienna: Braumüller.

The most interesting paper in this journal is an account of a fatal case of chronic arsenical poisoning from the use of magenta in the arts. The patient, a maker of garlands for graves, had been accustomed to colour artificial flowers, moss, &c., with magenta and iodine green. After death arsenic was detected in all the solids and liquids of the body, except the bones and the urine. Samples of magenta, obtained from various colour merchants in the city, were submitted to quantitative analysis, the result being that one alone was free from arsenic, the poison in the others ranging from 0·23 to the serious proportion of 2·7 per cent. The writers attach great importance to this case, as proving that fatal doses of arsenic may be absorbed through the skin, in the ordinary technical uses of magenta, without the ingestion of the poisonous colour.

CORRESPONDENCE.

FEES.

To the Editor of the Chemical News.

Sir,—In a trade journal the proprietors have instituted a new department called "Our Laboratory," which is said to be placed in charge of a highly-qualified analytical chemist. "The purpose is to render the chemical analysis of all products in which the readers are interested more popular and more generally useful than at present." This is to be brought about by "having samples analysed and publishing the results, together with such information, comment, or description as will tend to render the information afforded by the analysis available to all who are interested in the subject. Should samples be forwarded by any of our subscribers, the analysis shall be performed for *about half the usual rates*, we reserving the right to publish when we think fit the results. Sellers of articles can have their goods analysed and the results published for the usual analytical fee and by arrangement with the editor, *through whom* the customer will receive an ordinary certificate of analysis, and who will receive fees, and answer all inquiries." Mr. Editor, I have no fault to find with the proprietors of the journal for wishing to popularise and make analytical chemistry more useful; but I do object to them setting up as analytical chemists, and I also object to the highly-qualified analytical chemist doing the work for *less* than half the usual fees. What I would ask is—where has the reduction of fees to stop? A client of mine wrote for a quotation for an analysis. I quoted the usual fee. He wrote me to say that a well-known firm of wholesale chemists and druggists allowed him a discount of 25 p.c, from the usual fees. I find it is becoming a common practice. The usual fee will become so small shortly that it will be a difficult matter to allow 25 per cent. I think the above is one of the grievances of chemists who live by analytical work; and in my opinion the Institute of Chemistry will serve a very useful purpose if it unites chemists, and excludes, not only the incompetent, but the competent, who are ruining the profession by accepting very low fees.—I am, &c.,

George Whewell, F.C.S.

Exchange Chambers, Blackburn.

ASSIMILATION OF NITROGEN BY PLANTS.

To the Editor of the Chemical News.

Sir,—I fell gratified that you have considered Johnston and Cameron's "Agricultural Chemistry and Geology" a work sufficiently important to warrant the long notice of it which appears in your issue of Jan. 11. In referring to that notice I merely desire to explain that I have not omitted referring to Berthelot's investigations (see page 238), but these investigations merely show, not that plants absorb free nitrogen, but that nitrogen is, under the influence of the "electric effluvé," converted into compounds assimilable by plants.—I am, &c.,

Charles A. Cameron.

Dublin.

ON THE LUMINOSITY OF BENZOL, &c.

To the Editor of the Chemical News.

Sir,—With your permission I should wish to offer a few remarks on the paper "On the Luminosity of Benzol, &c.," which you report to have been read by Messrs. Frankland and Thorne at the last meeting of the Chemical Society.

Dr. Frankland claims credit for having "pointed out in 1852 that hydrogen, carbonic oxide, and marsh gas practically contribute nothing to the luminosity of coal gas, and that the only constituents of value were *benzol*, ethylene, propylene, butylene, and *acetylene*." (The italics are mine.)

I always thought that the non-luminosity of the flames of hydrogen and carbonic oxide had been known to every chemical schoolboy, and that the feeble luminosity of a fish-tail flame fed by *pure* CH_4 known at least to every *chemist*.

To pass to the positive part of Dr. Frankland's alleged discoveries in 1852, it is rather remarkable that he should then have insisted upon the importance of *acetylene* as a luminiferous agent. It is true the gas had been discovered many years before by E. Davy, but chemists had entirely lost sight of it, and it has always been my impression that it was *Berthelot* who re-discovered it, in 1859.

Now, as to the benzol, what I have to say is that in 1857, when I worked in Bunsen's laboratory, the existence of benzol in coal gas was there simply ignored; all the part absorbable by fuming vitriol was put down as so much "*ethylene*" plus so much "*ditetryl*." Now, in 1852, Dr. Frankland came fresh from Bunsen. *Bunsen's* knowledge of the subject could not have *de*creased between 1851 and 1857, and we have no evidence of Dr. Frankland at the time having added anything to what he had learned from his master.

I have not Dr. Frankland's original paper at my disposal, but from the abstract given in the *Jahresbericht* it appears that in his analysis he simply reported his sum-total of the carbon "vapours" present in the part absorbable by fuming vitriol, and assumed the percentage of such carbon vapours to approximately measure the luminosity of the gas.

Dr. Frankland, at the time, of course, looked upon that carbon as having been present in the gas (substantially) in the form of *olefines*. If he had thought that any noteworthy portion of it consisted of benzol, and that this benzol had any considerable share in the luminiferous power of this gas, he would have said so; but he does not. *Nobody*, in fact, dreamed of the paramount importance of benzol as a light-giver in coal gas until a little over a year ago it was *asserted* by *Berthelot* (as a sequence from an *erroneous* assumption), and *proved* by me in a paper "On the Proximate Composition of Coal Gas," which I communicated to the British Association, in Glasgow, in 1876, and subsequently published in your columns. In that paper I show that Berthelot's notion that ethylene could not publicly be present in more than traces in a pyrogenic gas is contrary to direct evidence; but I also prove that while hydrogen gas, impregnated with benzol to the extent of 3 per cent (by vol. of C_6H_6 vapour) gives a brilliantly luminous fish-tail flame, a mixture of C_2H_4 and hydrogen containing the same percentage of carbon vapour yields a flame like that of a Bunsen's burner.

In the introduction to my paper I distinctly stated that I was engaged in attempting, *by synthetical experiments, to determine the extent to which the several constituents of coal gas contribute to its luminosity*. A copy of my paper was forwarded to Dr. Frankland.

After the above I leave it to you and your readers, Mr. Editor, to form your own estimate of the merits of Dr. Frankland's latest scientific publication.—I am, &c.,

W. Dittmar.

Andersonian College, Glasgow,
January 30, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 27, December 31, 1877.

Constitution and Structure of the Meteoric Iron of Santa Caterina (Brazil); Conclusions drawn from its Characters respecting the History of the Me-

teoric Rocks, and especially the Habitual Association of Carbon with Iron Sulphide.—M. Daubrée.—The structure of polished sections of the specimens received by the author shows a decidedly breciaform character. The mass of iron has been reduced into a multitude of angular fragments, which have then been cemented together by a network of irregular little veins. These veins contrast in their yellow-bronze colour with the reddish grey tone of the nickeliferous iron. The substance which forms the chief mass dissolves in acids with evolution of hydrogen sulphide and deposition of sulphur, and is therefore a ferric sesqui-sulphide or pyrrhotine. The residue is coloured strongly black by graphite. Where the veins of pyrrhotine touch the iron they sometimes present a slender but brilliant margin, which has the characters of a phosphide. Other veins, much more slender than those of pyrrhotine, traverse at once the metallic iron and the veins of pyrrhotine, and are formed of magnetic oxide of iron, partly crystalline. In meteorites the sulphide of iron is mixed with carbon, as if the combination resulted from the action of carbon bisulphide upon iron. Possibly, also, the association of carbon with iron phosphide may result from the action of phosphorus sulphide upon metallic iron.

Condensation of Gases hitherto supposed Permanent.—M. Berthelot declared that he had witnessed M. Cailletet's experiments upon nitrogen and hydrogen. The liquefaction of hydrogen did not appear to leave any room for doubt, according to the succession of phenomena. The observations made with hydrogen have also furnished indications, not doubtful, in M. Berthelot's opinion, of the liquefaction of the gas, though less complete and more difficult to apprehend than in the case of nitrogen. From their aspect and their brief duration they represent the degree of attenuation of the liquid dust which is produced towards the end of the phenomena recognised in the case of nitrogen,—that is to say, in the period immediately preceding the disappearance of the mist. The extreme tenuity of the liquefied particles which constitute this mist of hydrogen, as well as their more rapid return to the gaseous state, agree perfectly with the properties of hydrogen as compared with other gases. What gives the experiments of M. Cailletet their character and their peculiar certitude is that they show, and enable us to compare—in one and the same transparent and limited space—the gas in three successive states; as a compressed elastic fluid, a pulverised liquid, and a liquid in great part released from pressure.

Cause of the Spontaneous Alteration of Eggs: a Reply to M. U. Gayon.—MM. A. Béchamp and G. Eustache.—The authors maintain the two following propositions:—The vitelline membrane is impenetrable to every organism coming from without. The production of Infusoria within the yolk of the egg is due not to germs coming from without, but, when it does take place, to the evolution of the normal microzymas (elementary granulations) of the yolk, which are transformed first into connected and articulated microzymas, and subsequently into bacteria.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 17, December 27, 1877.

The Abbé Laborde proposes a "writing telephone." It will suffice, he says, to separate the recipient, and to fix to one of the conducting wires a metallic plate, and to the other an iron point slightly rounded at its extremity. Between this plate and the point intended to complete the circuit must be placed a long band of paper, prepared as for Bain's electro-chemical telegraph, to which a regular movement must be imparted in the direction of its length whilst the telephone is in action. At each double vibration the iron point will make a black mark upon the paper: for if the metallic membrane determines a negative current as it approaches the fixed magnet it will produce a positive current on departing from it, and it is in this second current which, as it issues from the point, will mark its passage upon the paper.

Reagent for Alcohol.—M. Jacquemart.—The reagent is a solution of nitrate of mercury obtained by treating the metal with a suitable proportion of nitric acid of mean strength. The action of this acid nitrate upon ethylic alcohol is rapid. If a little ammonia is added to the mixture after the reaction a black precipitate is obtained, the more intense the greater the proportion of alcohol present. Methylic alcohol and other analogous liquids behave quite differently, and do not give a black precipitate with ammonia.

No. 1, January 3, 1878.

M. Milne-Edwards has been nominated President of the Scientific Association of France.

No. 2, January 10, 1878.

This issue contains no original chemical matter.

No. 3, January 17, 1878.

This issue contains no original chemical matter.

No. 4, January 24, 1878.

The electric light is to be utilised on a very large scale in connection with the approaching Exhibition at Paris.

A reward of 3000 francs is offered by the German Society for the Encouragement of Industry for an easy and accurate method of detecting the presence of glycerin in beer.

Rodent and marsupial animals enjoy a perfect immunity from the poisonous effects of *Belladonna* and the other Solanaceæ, and, according to the experiments of M. Battandier, mice may be fed for a week upon the seed of hemlock without injury.

M. H. Kaemmerer recommends tannin as a valuable agent in the analysis of potable waters. Wells in the vicinity of cemeteries, or which are contaminated with manufacturing refuse, may contain gelatin. The reagent and the water should be left in contact for twenty-four hours, and any sample which becomes turbid should be rejected as unfit for consumption.

Reimann's Färber Zeitung,
No. 1, 1878.

In this issue is contained a notice of the progress of the recently-founded Dyer's Institute in Berlin, which appears to be in a satisfactory position.

No. 2, 1878.

This issue contains nothing of general interest.

No. 3, 1878.

It appears that though magenta made by the arsenic process is no longer used for colouring confectionery, syrups, liqueurs, &c., yet these articles are still found to contain traces of the poison. According to Ritter, of Rouen, the source of this evil is to be sought not in the magenta or other colours employed, but in the glucose or starch-sugar so often used. This substance is obtained by the action of dilute sulphuric acid upon starch; and the acid being made from arsenical pyrites contains traces of arsenic, which thus finds its way into articles of food. As in Germany the brewers employ little malt and very much starch-sugar, the beer is thus liable to be contaminated.

Justus Liebig's Annalen der Chemie,
Band 190, Heft 1 and 2.

The Application of Ammonium Sulpho-Cyanide in Volumetric Analysis.—J. Volhard.

Volatility of Barium, Strontium, and Calcium.—Prof. J. W. Mallet.—The author finds that of the three metals just mentioned calcium is the most volatile and barium the least so. Whether lime and baryta are reduced by the vapour of sodium at very elevated temperatures is still undecided.

On Certain Compounds of the Amine Bases with Hydro-Ferrocyanic Acid.—Emil Fischer.—The author has obtained several complicated compounds by the action of ferrocyanides upon tetra-methyl-ammonium iodide, dimethyl-ethyl-phenyl-ammonium hydroxide, and diethyl-phenyl-azonium bromide.

Studies on the Phosphates.—E. Erlenmeyer.—The first of this series of papers treats of the phosphates of manganese. The authors (MM. Erlenmeyer and Heinrich), after an historical survey of previous researches on the same subject, describe the mono-mangano-phosphate, the dinitri-mangano-phosphate, the di-mangano-phosphate, and the tri-mangano-phosphate.

Potassium Xanthogenate as a Means for the Quantitative Determination of Carbon Bisulphide, Copper, and Caustic Alkali, in presence of Alkaline Carbonates.—Dr. E. A. Grete.—For the determination of the xanthogenate the weighed substance, dissolved in water, is titrated with a decinormal solution of copper. The yellow cupric xanthogenate, even in very dilute solutions, on prolonged stirring, is easily deposited in flocks, and the liquid becomes so clear that a further addition of the copper solution causes a slight turbidity readily perceptible at the side of the beaker, and which on further agitation is taken up by the pre-existing precipitate. The following precautions are needful:—The precipitation must never be attempted in very concentrated solutions. The process is greatly accelerated by the application of heat. For the determination of free carbon bisulphide a portion of the sample is weighed in a bulb-tube, which is then broken beneath the surface of an alkaline solution of potassa in a beaker, when the entire quantity is converted into xanthogenate of potassa. The solution is mixed with solution of bitartrate of potassa till neutralised, diluted if needful, and titrated with decinormal solution of copper. If the CS_2 is present in an impure state in the air, in gas, or in soils which have been treated with sulpho-carbonates and xanthogenates, the carbon bisulphide is distilled or aspired into a Will-Varrentrapp apparatus containing a few c.c. of alcoholic potassa lye, and titrated after the treatment above mentioned.

MISCELLANEOUS.

The Chemical Society's Research Fund.—The following grants have just been made from the Research Fund of the Chemical Society:—To Dr. Wright, for the continuation of his researches "On Chemical Dynamics," £50. To Dr. Armstrong £25, for an "Investigation of Camphor and Allied Bodies." To Dr. Carnelly, of Owens College, £20, for a research "On the Hydrocarbons Diphenyl, Ditolyl, Tolyl-phenyl, &c., and their Derivatives." To Mr. P. Phillips Bedson, of Owens College, £10, for a research "On Phenyl-acetic Acid and on the Constitution of Isatin." And to Mr. J. R. Crow, of Owens College, £5, for a research "On the Action of Zinc Ethyl on the Chloride of Vanadium."

MEETINGS FOR THE WEEK.

MONDAY, 11th.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 5.
—— Society of Arts, 8. "Explosions in Coal Mines," by Thomas Wills, F.C.S.
TUESDAY 12th.—Civil Engineers, 8.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
—— Photographic, 8. (Anniversary).
—— Anthropological, 8.
WEDNESDAY, 13th.—Society of Arts, 8. "The System of Cremation in Use upon the Continent," W. Eassie, C.E.
THURSDAY, 14th.—Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
—— Royal Society Club, 6.30.
—— London Institution, 7.
—— Society of Arts, 8. "Recent Improvements in the Metallurgy of Nickel," A. H. Allen, F.C.S.
FRIDAY 15th.—Royal Institution, 88. Weekly Meeting. "Zoological Distribution and some of its Difficulties," Dr. P. L. Sclater, 9.
—— Geological 1. (Anniversary).
SATURDAY, 16th.—Royal Institution, 3. "Carthage and the Carthaginians," R. Bosworth Smith, M.A.
—— Physical, 3. "On Grove's Gas Battery," H. F. Morley, M.A., B.Sc. "On the Drawing of Lissajous' Figures for the Stereoscope by his Pendulum Apparatus," S. C. Tisley. On the Same, Mr. Strop.

WATER ANALYSIS.—Prof. WANKLYN, Lecturer on Chemistry and Physics at St. George's Hospital, Public Analyst for Buckinghamshire, Buckingham, High Wycombe Peterborough, and Shrewsbury, has REMOVED to 7 Westminster Chambers, Victoria Street, S.W

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JANUARY, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Clear	0·000	0·009	0·090	0·114	24·40	8·230	0·460	0·78	1·760	13·2	3·70
West Middlesex	Clear	0·000	0·008	0·126	0·142	21·20	8·280	0·430	0·87	1·930	14·8	3·70
Southwark and Vauxhall	Slightly turbid	0·002	0·009	0·126	0·060	21·40	8·680	0·420	0·87	1·800	13·7	3·70
Chelsea	Clear	0·002	0·009	0·150	0·053	21·40	9·290	0·540	0·87	1·900	14·8	3·70
Lambeth	Slightly turbid	0·002	0·007	0·150	0·073	21·40	8·900	0·500	0·91	1·860	14·3	3·70
Other Companies.												
Kent	Clear	0·001	0·004	0·345	0·009	27·40	11·200	0·680	1·37	2·830	18·8	5·50
New River	Clear	0·001	0·008	0·135	0·025	21·90	8·960	0·420	0·87	1·030	15·4	2·80
East London	Clear	0·000	0·006	0·060	0·047	20·90	7·780	0·680	1·01	2·000	12·6	4·20

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 951.

METHOD OF OBTAINING THE COPPER FROM COPPER PYRITES WITH THE AID OF TWO WASTE PRODUCTS.

By HUGH M. WILSON.

THE burnt ore obtained from the pyrites kilns is treated with waste chloride of manganese liquor from the chlorine stills, which is pumped on to a layer of the ore several successive times. A large portion of the copper contained in the ore is thus extracted by means of the free acid always present in the still liquor. The chloride of copper solution is then run on to a sufficient quantity of soda-waste to convert the whole of the copper into sulphide by means of the sulphuretted hydrogen disengaged from the waste. The manganese and calcium salts now in solution can easily be separated from the sulphide of copper, which is thrown on to a drainer, well washed, and afterwards heated on iron plates in order to convert it into sulphate of copper, which is then treated with boiling-water and allowed to crystallise.

At chemical works where the chloride of manganese liquor is treated according to Weldon's method a modification of the above would be necessary, as that liquor could not in that case be employed. The burnt ore might be ground fine and calcined with common salt in a blind roaster furnace, and then, after separating the copper chloride by lixiviation, the treatment continued with above described.

The pyrites used in charging the burners for the above process should be treated in the following manner:—

The large lumps are crushed in a stone-crushing machine, and the dust and smaller portions sieved away from the larger pieces, which are then ready for use. The dust and smaller lumps are ground into a paste with water, spread on iron plates, and allowed to dry at a gentle heat. Before the mixture of pyrites and water is dry it can be marked out into the required size for charging the kilns, viz., about two inches square. The sulphur ore thus prepared has the advantage of being uniform in size, of burning spontaneously as it were, no additional heat being required to decompose it when once the burners are red hot, and of costing no more to obtain it in that form than by adopting the ordinary process of breaking the large lumps with hammers.

A modification of the process described is being carried on on a small scale; but it is not generally known, or it would be extensively adopted, owing to the simplicity and efficiency of its nature.

Heaton Mersey, January 31, 1878.

SOME REMARKS ON THE METAL DAVYUM.

By SERGIUS KERN, M.E. St. Petersburg.

UNFORTUNATELY, the quantity of davyum in the hands of the author is still so small that no serious experiments can be made. Most of the platinum ores used during the investigations contain 0·0008—0·001 per cent. of davyum, and only a few of certain ores contain 0·035—0·045 per cent., as the author mentioned before (CHEMICAL NEWS, vol. xxxvi. p. 114). The reactions of davyum were again carefully examined, and the uniformity of the davyum received was confirmed by analysing the metallic residue obtained by igniting the double ammonium compound of davyum. No foreign metals were present. The metallic residue just mentioned was strongly ignited in a porcelain tube, through which a free current of pure oxygen was passed. The osmium and ruthenium, if they were present, were obliged to fly away in the form of OsO_4 and RuO_2. The davyum, which was found to contain no metals of other groups, was dissolved in aqua regia. The reactions of the davyum solution with KHO, KNO_2, KCyS were again examined.

The reactions of davyum with these reagents were found to be the same as mentioned in one of the author's former papers (CHEMICAL NEWS, vol. xxxvi. p. 155). If these reactions are compared with the similar reactions of iridium, platinum, rhodium, and palladium, the difference between them may be seen at once. (From osmium and ruthenium the davyum was liberated by the above-mentioned Fremy's process, used by him for the treatment of osm-iridium ore). The reaction of davyum with hydrogen sulphide was more closely examined: in acid solutions a brownish precipitate is immediately produced, which being dried turns black. The precipitation is complete. The davyum sulphide is soluble in aqua regia; ignited, it turns light brownish, and then is insoluble in aqua regia.

The author having at present only a very small amount of the metal, is desirous of investigating the davyum further when a sufficient quantity of it will be extracted. This, of course, demands much time, labour, and expense, owing to the rarity of the davyum.

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.

By H. CARRINGTON BOLTON.

(Continued from p. 25).

(3.) THE organic acids employed in this investigation were chiefly citric, tartaric, and oxalic; a few tests were made also with malic, formic, acetic, benzoic, pyrogallic, and picric acids. Of the solid acids, solutions saturated in the cold were used, unless otherwise specified; of the liquid acids, ordinary commercial products. The behaviour of the minerals with these acids was studied in a very simple manner:—The mineral to be examined was carefully freed from its associated gangue or mineral, finely pulverised in an agate mortar, and a portion placed in a test-tube; the solution of the acid was then added, and the resulting phenomena, in the cold and on boiling, carefully noted Sometimes satisfactory conclusions were reached only by comparison of a number of tests under varying conditions, as to amount of acid, time of heating, &c. In some cases, to be mentioned in due course, the partial decomposition of the mineral was ascertained by filtering from the residue and testing the solution with an appropriate reagent; in others, by examining the disengaged gas with a suitable test-paper.

CARBONATES.

(4.) The natural carbonates dissolve with effervescence more or less readily in dilute and strong, cold and hot solutions of citric, tartaric, oxalic, malic, formic, benzoic, acetic, pyrogallic, and picric acids, the relative power of these acids being approximately in the order in which they are named. The behaviour of the carbonates with citric acid may be summarised as follows:—

(*a*) Calcite, gurhofite, witherite, strontianite, cerussite, baryto-calcite, and malachite dissolve rapidly in the cold.

(*b*) Dolomite, ankerite, rhodochrosite, Smithsonite, and azurite, are more feebly attacked in the cold.

(*c*) Magnesite and siderite are not attacked in the cold.

On heating, all the above carbonates dissolve very rapidly, except siderite, which is more slowly attacked.

From strong, nearly neutral, solutions of calcite, gurhofite, and some other calcium minerals, a white precipitate of calcium citrate forms on cooling; cerussite also deposits a white precipitate on cooling.

It is evident that a solution of citric acid effects the decomposition of mineral carbonates with sufficient ease to render it extremely useful where hydrochloric acid can not be conveniently employed. The organic acid acts, however, somewhat more slowly; in fact, time appears to be an important factor in studying these reactions. On some minerals the organic acid has at first no effect, and an appreciable time elapses before bubbles of carbonic anhydride appear, indicating the decomposition of the mineral; this is especially noticeable with dolomite and azurite. The time of incipient action varies also with the acid employed.*

Owing to the viscosity of a concentrated solution of citric acid the liberated gas has difficulty in escaping, and often remains attached in bubbles to the powder until sufficiently large bubbles have formed to ascend through the syrupy liquid: this, of course, has reference to examinations made in the cold. Moreover, the precaution was observed of distinguishing between the escape of bubbles of air entangled by the powdered mineral and a true liberation of carbonic anhydride. These minute details are mentioned, because observation of them is necessary to obtain the same results as those recorded in the first part of this section. Magnesite and siderite were repeatedly tested, and always refused to effervesce with a cold solution of citric acid, a reaction which distinguishes them from other carbonates.

5. In making this investigation we have constantly borne in mind the possible employment of the methods in the field, and have conducted the tests in the simplest manner with that end in view. Since it is seldom convenient in field work to obtain the minerals in fine powder, an examination was made of the action of citric acid on the *massive* carbonates: and by way of comparison the behaviour of the same with hydrochloric acid was also noted. The results may be summarised as follows:—(1) Signifying that the minerals effervesce quickly when the acid is dropped on their smooth surfaces; (2) that they are feebly and slowly attacked; (3) that they do not effervesce.

Mineral.	HCl. Sp. Gr. 1·055.	Citric Acid.
Calcite	1	1
Dolomite	3	3
Gurhofite	1	1
Ankerite	2	3
Magnesite	3	3
Siderite	3	3
Rhodochrosite	3	3
Smithsonite	2	3
Witherite	1	2
Strontianite	1	2
Baryto-calcite	1	2
Malachite	1	2
Azurite	2	?

Porous minerals, and those having highly polished cleavage or crystalline surfaces, appear to resist the action of the acids, but for very different reasons; the former (smithsonite, for example) absorb the liquid and conceal its action within their pores; the latter (dolomite, siderite, &c.) seem to repel the liquid, or rather to prevent its actual contact. In the latter case the action of the acid may be rendered visible by scratching the surface with a knife and applying the acid liquid to the roughened surface or to the small amount of powder produced by the scraping. The observations above recorded were made on smooth surfaces.

In earthy minerals, the acid should be applied repeatedly at the same point until, the pores being filled, the action of the acid on the surface becomes apparent.

6. The mineral carbonates behave with a solution of tartaric acid much in the same manner as with citric acid, but the tartrates being in general a little less soluble than the citrates, crystalline precipitates form more readily on cooling the saturated solutions.

The results recorded below were obtained with a solution saturated in the cold:

(*a*) Calcite, gurhofite, witherite, strontianite, cerussite, and baryto-calcite dissolve readily in the cold; on boiling, the action is increased, and the solutions deposit crystalline precipitates on cooling; the precipitates of calcium tartrate and of barium tartrate form readily, and may be recognised with a little experience.

(*b*) Dolomite, ankerite, rhodochrosite, smithsonite, malachite, and azurite effervesce feebly in the cold, and dissolve rapidly on heating. Dolomite and smithsonite deposit crystals on cooling the solutions; malachite yields a bluish green precipitate; azurite dissolves readily without residue.

(*c*) Magnesite and siderite are not attacked in the cold, but dissolve readily on heating. The specimen of siderite from Roxbury effervesced very slightly in the cold and appeared to be more soluble than the specimen from Dauphiny.

7. Oxalic acid decomposes the carbonates in a similar manner, forming, however, still more insoluble precipitates, which are in some cases characteristic of the bases contained in the minerals; especially is this true of the white pulverulent calcium oxalate, the light yellow granular ferrous oxalate, the beautifully feathered crystals of barium oxalate, and the heavy white precipitate of lead oxalate. Ankerite contains enough ferrous carbonate to communicate a decided yellow colour to the insoluble calcium salt, by the formation of ferrous oxalate. Baryto-calcite dissolves freely on boiling, with formation of insoluble calcium oxalate; by decanting the supernatant liquid it deposits as it cools the feathered needles characteristic of acid barium oxalate, easily distinguishable from the stouter, lengthened, monoclinic prisms of oxalic acid which likewise form in concentrated solutions.

Magnesite, which resists the action of cold citric and tartaric acids, succumbs to oxalic acid. Siderite is also more readily decomposed. Malachite and azurite are feebly attacked in the cold, dissolve slowly on heating, and yield precipitates, which are respectively—grayish green and bluish white in colour. Cerussite and smithsonite also furnish solutions which deposit crystalline precipitates on cooling.

8. Acetic acid does not act so enegetically on the mineral carbonates as do the preceding; moreover, on boiling, the volatile acid distils off and the solution becomes weaker as the heating is continued; whereas with solutions of the solid acids, boiling increases their concentration and their decomposing power. We conjecture that experimenters in this direction have been deterred from further research by the unsatisfactory nature of the reactions with acetic acid. And yet, if we may trust the ancient chronicles of Rome, the behaviour of minerals with this acid was investigated at a very early period; we refer to that much disputed tradition which represents the celebrated Carthaginian general, Hannibal, applying vinegar to the removal of rocks that obstructed his passage across the Alps, in his march on the Roman capital:—

"Diducit scopulos et montem rumpit aceto."*

Glacial acetic acid does not in the slightest degree dissolve calcite; even pure precipitated calcium carbonate

* The interesting subject of the Velocity of Chemical Reactions has recently been investigated in certain cases by Boguski and Kajander (*Berichte der Deut. Chem. Gesell., Berlin*, ix., 1646, and x., 34). They find that when nitric, hydrochloric, and hydrobromic acids, of the same concentration, act upon marble, the velocity of evolution of carbonic anhydride is inversely proportional to their molecular weights. Cf. *American Journal of Science* [3], xii., p. 299. It will be interesting to ascertain whether this law holds good with organic acids.

* Juvenal, Satire X.

does not effervesce when boiled with glacial acetic acid; but on adding one-fourth part of water, effervescence begins at once and the carbonate dissolves freely.

The behaviour of carbonates with acetic acid may be summarised as follows (sp. gr. of acid = 1·037).

(*a*) Calcite, gurhofite, witherite, cerussite, baryto-calcite, and strontianite effervesce freely in the cold and dissolve rapidly on heating.

(*b*) Dolomite, ankerite, smithsonite, and azurite effervesce slightly in the cold, the action being increased on boiling.

(*c*) Magnesite, siderite, rhodocrosite, and malachite are not attacked in the cold, and dissolve more or less readily on boiling.

9. Formic acid (sp. gr. = 1·060) acts rather more powerfully than acetic; cerussite gives a peculiarly beautiful and characteristic deposit of lustrous white crystals. Malic acid also acts quite energetically; but the difficulty of obtaining it in a state of purity, and its high price, will prevents its use in this connection. It does not seem especially desirable to extend the list of organic acids; for though their number is legion, but few are commercial articles; some interest might be attached to a comparison of their decomposing power, but a practical application to the examination of minerals is very doubtful. To test the probabilities of their action, however, a few experiments were made with solutions of picric, benzoic, and pyrogallic acids.

A strong hot solution of picric acid (carefully freed from nitric acid by re-crystallisation) decomposes calcite, dolomite, and witherite very readily. A moderately strong hot solution of benzoic acid dissolves calcite freely, and a crystalline precipitate falls on cooling. Dolomite dissolves on boiling. Pyrogallic acid attacks calcite in the cold, and dissolves it on boiling, with formation of a white precipitate, while the supernatant liquid turns dark in colour through absorption of oxygen.

(To be continued)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 7, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER confirmation of the minutes, &c., the names of the following gentlemen were read for the first time:—T. W. Drinkwater, S. A. Goldschmidt, W. J. Macadam, S. S. O. Morris, W. A. H. Naylor, A. N. Pearson, and J. Spencer. The following were duly elected Fellows of the Society:—T. C. Cloud, G. F. Dowdeswell, A. Ginders, H. R. Hind, J. Woodland, S. P. Pickering, T. F. Harris, G. H. Spring, W. J. Williams, G. S. Taylor, A. Linnell, J. V. Elsden, A. H. Elliott, C. B. Fox, A. Jamieson, A. H. Hooker, D. A. Louis, W. Watson, W. H. Ellis, J. Hadkinson, W. D. Harland, R. Bodmer, H. B. Nason, G. E. Stodart, and G. Kühnemann. Mr. E. C. Gill was elected an Associate.

The first paper was entitled, "*The Alkaloids of the Aconites: Part II. On the Alkaloids contained in Aconitum Ferox*," by Dr. WRIGHT and Mr. LUFF. The alkaloid obtained from *A. Ferox* differs from that extracted from *A. Napellus* in that the latter, aconitine, yields well-crystallised salts with facility, whilst the former, pseudaconitine, forms crystallisable salts with difficulty. Aconitine under certain conditions loses the elements of water, forming a crystallised anhydro-derivative. When saponified aconitine breaks up as follows:—

$$C_{33}H_{43}NO_{12} + H_2O = C_7H_6O_2 + C_{26}H_{39}NO_{11},$$

benzoic acid and a new alkaloid being formed. Pseudaconitine likewise forms an anhydro-derivative, but by the action of saponifying agents it forms dimethyl-protocatechuic acid, and a new alkaloid quite different to that produced from aconitine. The formula of pseudaconitine is $C_{36}H_{49}NO_{12}$; a formula previously given, having O_{11}, was rendered inaccurate by the presence of some of the anhydro-derivative, apo-pseudaconitine, $C_{36}H_{47}NO_{11}$. Pseudaconitine was obtained from the roots of *A. Ferox* by percolating with alcohol acidulated with 0·05 per cent (by weight) sulphuric acid. The impure product from this process was dissolved in ether, filtered, mixed with about half its bulk of light petroleum, and crystallised, some resinous matter was removed by alcohol, and the purified alkaloid re-crystallised several times. By analysis the following numbers were obtained:—C, 63·09; H, 7·47; N, 2·12; theory requires—C, 62·88; H, 7·13; N, 2·04. By conversion into the nitrate, re-crystallisation, and re-conversion into nitrate, the following numbers were obtained:—C, 62·71; H, 7·44; N, 2·07; Au in the gold salt, 19·24; theory requiring Au, 19·10. A determination of nitrogen by combustion with oxide of copper and metallic copper in a Sprengel vacuum, &c., gave 2·06 N. Pseudaconitine is far more soluble in alcohol and ether than aconitine; it forms transparent needles, and sandy crystals, but is apt to separate as a varnish if not evaporated extremely slowly. Air-dried, the crystals are hydrated; at 100° they lose their water with partial fusion. If the alkaloid be dissolved in just sufficient dilute warm nitric acid to form a nearly neutral salt, a few drops of concentrated nitric acid be added and the whole stirred vigorously, crystallisation takes place. The sulphate, hydrochloride, acetate, oxalate, &c., will not crystallise. The gold salt of pseudaconitine is distinctly crystalline, $C_{36}H_{49}NO_{12}.HCl.AuCl_3$. Pseudaconitine is sparingly soluble in water; it crystallises with H_2O, and melts at 104° to 105°. Aconitine crystallises anhydrous; melts at 189°. By heating to 105° a new uncrystallisable base is formed containing—C, 65·51; H, 7·5. A similar substance is obtained by heating the acetate to 130° to 140°. When heated to 100° in a sealed tube with alcoholic soda for twelve hours, pseudaconitine splits up into dimethyl-protocatechuic acid and a new base pseudaconine, $C_{36}H_{49}NO_{12} + H_2O = C_9H_{10}O_4 + C_{27}H_{41}NO_9$. The reaction takes place without a sealed tube in twenty-four hours, but more of a resinous by-product is formed. The reaction was investigated quantitatively. In melting-point and physical and chemical properties the acid agreed with dimethyl-proto-catechuic acid. The crude alkaloids obtained from *A. Ferox* on saponification yielded some benzoic acid, from which circumstance the authors think that it probably contained small quantities of aconitine, either present in *A. Ferox* or from the admixture of a few roots of *A. Napellus*. Pseudaconine does not crystallise; it is soluble in water, forming a strongly alkaline solution having a bitter taste, but not producing the slightest tingling; its analysis and properties are given. Saponifying agents, at temperatures above 100°, form dimethyl-protocatechuic acid and apo-pseudaconine, $C_{27}H_{39}NO_8$, which closely resembles pseudaconine. Dilute or concentrated mineral acids saponify pseudaconitine when heated with that substance. Tartaric acid forms apo-pseudaconitine. Inorganic acids, with certain precautions, also yield apo-pseudaconitine. Glacial acetic acid yields acetyl-apo-pseudaconitine; anhydrous acetic acid furnishes the same substance. Benzoic acid yields benzoyl-apo-pseudaconitine. The authors then give the constitutional formulæ of the above substances, and point out that pseudaconitine is closely related to the opium alkaloids narceine, narcotine, and oxy-narcotine, which all give rise to derivatives of dimethyl-protocatechuic acid; moreover, all the natural alkaloids which have been split up by saponification yield acids of the aromatic series. Other bases from the crude aconitine were isolated; in fact about one-fith of the commercial article consists of substances far less active than pseudaconitine. The authors therefore recommend that for medicinal use the alkaloid should be separated by con-

version into the nitrate, which is almost insoluble in 10 per cent nitric acid.

The PRESIDENT said that the Society was deeply indebted to Dr. Wright and Mr. Luff for their elaborate research, which they must have carried out at no small risk, the substances being of such a poisonous nature.

In answer to some critical remarks of Mr. KINGZETT, Dr. WRIGHT stated that he wished to withdraw a statement made by him at the Pharmaceutical Conference, viz., "that the alkaloid obtained by Dr. Paul and Mr. Kingzett from Japanese aconite was pseudaconitine."

The next communication was entitled, "*Notes on the Tannins*," by Dr. PAUL and Mr. KINGZETT. The authors during the examination of various tannins completely verified the statement of H. R. Procter, that no two processes for the estimation of tannin give similar or comparable results, although, when the same process is used against products of the same nature, the results are tolerably constant; *i.e.*, cutch can be compared with cutch, mimosa with mimosa, &c., but not cutch with tannin, or mimosa with cutch. The term tannin includes not one common substance, but several astringent principles obtained from different plants. After detailing experiments the authors conclude that (1) the supposition that natural tannin from gall-nuts is a glucoside is rendered doubtful; (2) the astringent principle common to cutch and extract of mimosa bark is a glucoside, and yields on decomposition unfermentable sugar and a peculiar acid distinct from gallic acid.

The next paper was read by Mr. E. RILEY, "*On the Estimation of Phosphorus in Iron and Steel.*" The author instituted a series of experiments as to the relative values of the two methods of determining phosphorus in iron, the molybdate and the magnesia processes. The analyses were carried out by several experimenters working independently, and as a general result the author concludes that the molybdate process always gives too low a percentage, and that the magnesia method is the only one to be trusted. Some pure peroxide of iron, almost free from phosphorus, was carefully prepared, the trace present determined, and portions, after mixing with known weights of pure phosphate of magnesia, analysed; the results given by the magnesia method were quite satisfactory and concordant. The process as given by the author is as follows:—The substance is dissolved in strong hydrochloric acid, and after dilution, reduced with sodium sulphite, the excess of sulphurous acid expelled from the solution, which is then nearly neutralised with ammonia. Acetate of ammonia is added and the liquid boiled; the whole of the phosphoric acid in the solution is thus precipitated; if enough peroxide of iron is not present some dilute solution of perchloride must be added. The precipitate is filtered and the filter dissolved without washing in strong hydrochloric acid, and thoroughly washed. The solution of phosphoric acid with some iron is then evaporated to a small bulk, about 15 c.c.; to this 13 grms. of citric acid are added, the solution is neutralised with 0·960 ammonia, and 20 to 30 drops of magnesia solution added; then a moderate amount of 0·880 ammonia, so as to make the liquid strongly alkaline; the total bulk should not exceed 50 c.c. After standing two days and nights with occasional stirring, the precipitate is filtered off, washed with ammonia water, dried, ignited, and weighed. The paper contains many analyses.

Dr. WRIGHT enquired if the molybdate precipitate was weighed directly, or was re-dissolved and precipitated.

Mr. WARINGTON thought the low percentage of phosphorus with the molybdate process might be due to the presence of chlorides; they should be decomposed by evaporating to dryness with sulphuric acid. From the paper he should gather that too much citric acid had been used, otherwise the magnesia precipitate would come down completely in three hours.

Mr. RILEY replied that if the molybdate precipitate had to be re-dissolved up, &c., he failed to see that it had any advantage either in time or accuracy over the magnesia method; that hydrochloric acid must be used for solution, and that unless 13 grms. of citric acid were used results would be obtained which were quite fallacious.

The next paper was read by the PRESIDENT, Dr. RUSSELL taking the Chair, and was entitled, "*An Enquiry into the Action of the Copper-Zinc Couple on Alkaline Oxy-salts*," by Dr. GLADSTONE and Mr. TRIBE. In 1873 Prof. Thorpe proved that the couple converts all the nitrogen of nitre in the presence of water into ammonia. The authors had previously observed that nitrites were first formed, and have now made an exhaustive study of the reaction. This chemical change starts somewhat energetically, then diminishes considerably, again increases, and finally ends more rapidly than it began. Ammonia and its equivalent of potash slowly increase from the commencement until the time when the maximum amount of nitrite is produced, when this salt rapidly breaks down, and is of course accompanied by an increasing amount of the alkalies. Solutions of ammonia containing 0·026 and 0·256 per cent increase the action of the couple, but stronger solutions diminish it. Solutions of potash from 0·08 to 60 per cent increase the change. By pouring a 10 per cent solution of nitre with enough copper sulphate to colour the liquid distinctly on to some granulated zinc in a tap funnel, and allowing it to remain a few seconds, enough nitrite is formed to give the characteristic green colour of copper nitrite, and to give a blue colouration with starch, potassium iodide, and acetic acid. The latter reaction can be used as a delicate test for nitrates; 5 c.c. of solution, 12 drops of copper sulphate, and 4 to 5 pieces of zinc foil, 1 by ½ inch; allow to stand for three minutes, then pour into 5 c.c. of the starch solution containing potassium iodide and acetic acid. On the whole the authors think that the following is the most probable explanation: that the two metals electrolyse the nitre with the formation of nitrate of zinc, the reduction being effected at the negative pole through the agency of the potassium. Many experiments were made, but without absolutely settling the question. By electrolysing, potassium nitrate solution in a V shaped tube zinc nitrate was formed in the zinc limb, and potassium hydrate with smaller quantities of potassium nitrite and ammonia in the copper limb. The copper-zinc couple converts potassium chlorate readily into potassium chloride. No chlorites or hypochlorites were formed. By electrolysing the greater part of the hydrogen escapes as gas instead of the potassium chlorate being converted into chloride, the reason being that with the couple the hydrogen is probably wholly occluded the moment it is set free; in electrolysis only a small quantity of the gas is condensed by the negative plate. The authors consider the following statements proved:—1. The action of the copper-zinc couple on these oxysalts is of an electrolytic nature. 2. The negative radical combines with the zinc, whilst the positive radical or its equivalent of hydrogen from decomposed water is set free against the copper crystals. 3. The reduction and hydrogenisation of the salt take place in the immediate vicinity of the negative metal; also, it is probable that hydrogen is actually set free against the copper, but is condensed by the finely-divided metal, and in that condition does its work of reduction and hydrogenisation. The action of the couple on ammonium nitrate was found to be substantially the same. If the reaction be attempted at or near the boiling-point the nitrite formed is decomposed, nitric oxide being evolved.

The last paper was by Mr. H. C. JONES, "*On a New Method for the Determination of Boiling-points.*" A piece of glass tube, 4 m.m. internal diameter and 200 m.m. long, is bent in a U, so that the one end which is open extends at least 15 m.m. beyond the other which is closed. The bend is made in the form of a circle about 20 m.m. in diameter. The liquid, two or three drops of which will be quite enough for the determination, is introduced into

the closed end of the U-tube; the open end is placed underneath the surface of some mercury contained in a small porcelain crucible. The whole is then slung by means of copper wire into a water or paraffin bath, and the temperature of the latter gradually raised. The liquid will of course boil and the vapour drive before it the air. On cooling, the whole tube, which the author calls a tension-tube, is filled with mercury, a bubble of liquid occupying the top of the bend. The tube is then inverted and the liquid transferred to the closed end of the tube. Any water or paraffin is now removed from the tube, and some mercury emptied from the lower limb. The method of determining the boiling-point is as follows:—The tube is immersed in a paraffin bath, care being taken that the open end is freely exposed to the air. The temperature is then gradually raised, and as the temperature approaches the boiling-point of the substance, the mercury falls in the closed limb, the tube being gently tapped. At the moment the mercury levels in the two limbs are equal the temperature of the bath is taken by a delicate thermometer placed close to the liquid in the closed limb. The bath is allowed to cool, and the temperature at which the levels pass each other again noted; and so six observations are made, the mean of which gives the uncorrected boiling-point. Many determinations are given in the paper, which agree well with each other. The advantages of the method are obvious, the small quantity of the substance required being one of the most important. Moreover, the tension-tube can be labelled and put away for future verification. By using a spermaceti bath boiling-points up to 300° C. can be determined.

The Society then adjourned to February 21, when "A Lecture on Laboratory Experiences on Board the *Challenger*," will be given by Mr. J. Y. Buchanan.

NOTICES OF BOOKS.

Experimental Researches in Pure, Applied, and Physical Chemistry. By E. FRANKLAND, Ph.D. (Marburg), D.C.L., F.R.S., Professor of Chemistry in the Royal School of Mines. London: John Van Voorst. 1877.

THIS goodly volume, of more than a thousand pages, contains the researches of a man who can scarcely be said to have much passed the prime of life, and who has before him, as we hope and believe, a sufficiency of energy, of enthusiasm, and of lifetime to produce a second thousand pages of original matter. It is a good custom, and one which is fortunately on the increase, for a distinguished investigator to publish his researches during his lifetime. A compiler can never do justice to an author's work, which he collects and arranges; nor would it have been possible for any compiler to add the introduction to each chapter, showing its scope and general bearing, in the complete manner in which Prof. Frankland has performed this task. The researches extend over thirty years of active scientific work; they embrace original memoirs, Government reports, addresses, and lectures, and they are collected from various English and Foreign Transactions and Journals. The Pure Chemistry occupies ten chapters; Applied Chemistry, four chapters; and Physical Chemistry, four chapters; while the separate memoirs are no less than sixty-four in number.

The first chapter, of twenty-five pages, explains the system of notation adopted throughout the work, and is an embodiment of the memoir entitled "Contributions to the Notation of Organic and Inorganic Compounds," read before the Chemical Society in 1866. The author, so long ago as 1858, proposed the adoption of this system in a Royal Institution lecture, and he has for many years adopted it in his lectures. So enthusiastic is he, as to its value, that he affirms that "by means of this method students arrive at the same point in their curriculum in about two-thirds of the time necessary under the older systems." A complete table of atomicities is placed at the end of the chapter, in which nitrogen, phosphorus, vanadium, arsenic, antimony, and bismuth figure as pentads; while sulphur, selenium and tellurium, osmium and its associated metals, and the metals of the iron group appear as hexads. It is, we think, a little unsatisfactory to have to place nitrogen and the old members of the triad group away from boron and gold; while the placing of oxygen and sulphur in a separate group, and of sulphur in the same group with iron and manganese, should not be done without an overwhelming mass of cogent reasons. *Semi-molecule* is an ugly term, unless we change our usual definition of molecule; a *bond* is a strange expression for force acting along a line; and we cannot think that the "internal arrangement of the atoms composing alcohol," or any other substance, can be inferred, much less known. Yet these hypotheses, if accepted not too literally by the student, will no doubt enable him to group together large classes of facts with a facility which the older notation did by no means afford.

The second chapter discusses the "Transformation of Cyanogen into Oxatyl." The investigation was commenced by Kolbe and Frankland in 1847, and finished in the summer of the following year. At this time Frankland was only 22 years old, while Kolbe was scarcely 30. Their experiments led to the conclusion that it would be possible to prepare from the nitriles of propionic and butyric acids the corresponding and hitherto-unknown alcohols.

In the third chapter we find a discussion of the results of "The Action of Potassium upon Ethylic Cyanide," and of the "Polymerisation of Ethylic Cyanide." This investigation was also carried out in conjunction with Kolbe, in 1847-8. The main object of the experiments—the separation of the radical ethyl—was not effected, but unexpected results of great interest were obtained; and *ethylic hydride*, *cyanethine*, *nitrate of cyanethine*, and *cyano-platinic chloride* were obtained for the first time.

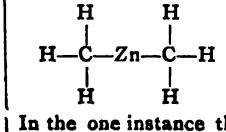
In Chapter IV. we have an account of the "Isolation of the Alcohol Radicals," an investigation commenced in the winter of 1847 at Queenwood College, and continued at Marburg and Giessen. Ethylic iodide was submitted to the action of potassium in closed tubes, at elevated temperatures; the gaseous products were found to consist of equal volumes of ethylene and ethylic hydride, according to the equation—

$$2C_2H_5I + K_2 = C_2H_4 + C_2H_6 + 2KI.$$

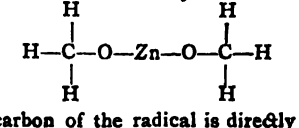
Zinc was then substituted for the potassium, and the radical ethyl was successively isolated (1848). Amyl was also isolated from its iodide; ethylic iodide was shown to be decomposed by solar light in the presence of mercury; and marsh gas was proved to be the first term of a new homologous series, viz., the hydrides of the radicals of the methyl series. Five new compounds were discovered during this investigation—*ethyl*, *ethylic hydride*, *amyl*, *amylic hydride*, and *amylene*.

Chapter V. details the author's important synthetical researches on organo-metallic bodies. The term *organo-metallic* was introduced to designate the members of a family of compounds which contain a "positive organic radical united *directly* with a metal." Such bodies are to be distinguished from those organic compounds which contain metals indirectly united to each other: thus zinc methyl is an organo-metallic body, while zincic methylate is an organic body containing a metal. This difference the author illustrates by his graphic formulæ in the following manner:—

Zinc Metal.



Zincic Methylate.



In the one instance the carbon of the radical is directly united with zinc, in the other it is indirectly united with

the zinc by the dyad oxygen. Zinc ethyl and zinc methyl were discovered on July 12th, 1849, at Marburg. "After making the reaction for the isolation of methyl, by digesting methylic iodide with zinc, and after discharging the gases, I cut off the upper part of the tube, in order to try the action of water upon the solid residue. On pouring a few drops of water upon this residue, a greenish blue flame several feet long shot out of the tube, causing great excitement among those present. Professor Bunsen, who had suffered from arsenical poisoning during his researches on cacodyl, suggested that the spontaneously inflammable body, which diffused an abominable odour through the laboratory, was that terrible compound, which might have been formed by arsenic present as an impurity in the zinc used in the reaction, and that I might be already irrecoverably poisoned. These forebodings were, however, quelled in a few minutes by an examination of the black stain left upon porcelain by the flame; nevertheless I did afterwards experience some symptoms of zinc-poisoning." Zinc amyl was afterwards prepared in Liebig's laboratory at Giessen, and further work on organo-metallic bodies was continued by Prof. Frankland in the laboratories of the College of Civil Engineers at Putney, Owens College, Manchester, St. Bartholomew's Hospital, and the Royal Institution. In the course of this investigation it became evident to the author that the atoms of various bodies only permitted the attachment of a fixed and definite number of the atoms of other elements; and this observation constituted the basis of the doctrine of atomicities, or valency of elements. The hypothesis was communicated to the Royal Society on May 10th, 1852. The law of variation in the atomicity of elements was made several years later, and was first published in the author's "Lecture Notes for Chemical Students," in 1866. He explained it by the assumption that "one or more pairs of bonds belonging to an atom of the same element can unite, and, having saturated each other, become as it were latent." For example, pentad nitrogen becomes a triad when one pair of its bonds becomes latent, and a monad when two pairs become latent by combination with each other. In 1856 the author read a paper before the Royal Society "On a New Series of Organic Compounds containing Nitrogen." Ethyl was substituted for oxygen in nitric oxide, and methyl in sulphurous anhydride. Two years later Wanklyn procured acetic acid by the action of potassium methyl on carbonic anhydride. In this fifth chapter the discovery of no less than twenty-four new organic compounds is announced; twelve belonging to the zinc series—zinc ethyl, zinc amine, zinc oxamide, &c.; four to the mercury series—mercuric amylide, iodamylide, &c.; and eight belonging to the tin series—stannous ethide, stannic diethoxide, &c.

The sixth chapter is devoted to *organo-boron compounds*. Fourteen new compounds are described, three belonging to the methyl series, of which boric methide is the most important; and eleven belonging to the ethyl series, of which boric ethide is the most important. Then bodies were produced by the action of zinc ethyl and zinc methyl upon boric ethylate. The experiments extend over fourteen years, 1862 to 1876.

The next chapter gives an account of the author's "Synthetical Researches on Acids of the Lactic Series." The results were made known in 1866. No less than *twenty-nine* new compounds are described in the memoir: among these we find dimethoxalic acid, diethoxalic acid, amylethoxalic acid, diamyloxalic acid, and some of their compounds. These experiments naturally led to synthetical researches on acids of the acrylic series, which resulted in the discovery of fifteen new compounds—among them methacrylic acid, ethyl-crotonic acid, and cupric ethyl-crotonate.

The ninth chapter contains those papers relating to the synthesis of the acids, of the fatty or acetic series. In this, as in several of the preceding researches, the author worked conjointly with Mr. B. F. Duppa. The experiments resulted in the production of the higher members of the acetic or fatty series of acids by direct synthesis from acetic acid. Three distinct series of bodies were produced—(*a*) carbo-ketonic ethers, (*b*) ethereal salts of the fatty acids, and (*c*) ketones. Twenty-seven new compounds were produced.

The final chapter of this first division of the work, on "Pure Chemistry," gives an account of some miscellaneous work which was accomplished between 1853 and 1863. The first of these four papers relates to an improvement in apparatus for the analysis of gas; the second gives the analysis of many specimens of air from Mont Blanc, collected in 1859; the third describes a new method for the ultimate analysis of organic compounds containing mercury; while the fourth describes the behaviour of iron and steel when ignited in highly-compressed oxygen.

The second section of "Experimental Researches" relates to Applied Chemistry, and extends over nearly four hundred pages. The first chapter relates to *Artificial Light*, and embodies an account of experiments made at various times between 1852 and 1865. The first paper relates to the manufacture of hydrocarbon gas, and it contains comparisons between the illuminating power of common coal-gas as supplied to London in 1851 and in 1876. This is compared with the illuminating power of cannel-gas, which is supplied to the Houses of Parliament and Government offices only, and which has more than twice the illuminating power of ordinary gas: 1000 cubic feet of cannel-gas costs six shillings, and gives as much light as 2000 cubic feet of common gas, costing eight shillings. The second paper treats of the igniting point of coal-gas, and the experiments were made in reference to an explosion of gas which occurred in 1862. The third paper discusses the use of metallic magnesium as a source of light. Magnesium gives 265 times as much light as good coal-gas, with an absolute equal thermal effect; but the difference of price is so great that, at present at least, there is no chance of its superseding gas. The following shows the relative prices of magnesium, stearine candles, and gas, in order to obtain the same amount of light for ten hours:—

	£	s.	d.
2¼ ounces of magnesium	1	6	3
20 lbs. of stearine candles	1	0	0
404 cubic feet of coal-gas..	0	1	9½

The four papers relating to artificial lighting is on a new form of gas-burner.

In the second chapter of the section on Applied Chemistry the very important subject of *Drinking Water* is fully discussed. The chapter extends over a hundred and thirty pages, and the experiments were made between 1865 and 1876. The whole subject is treated very exhaustively—the analysis of potable waters, the examination of the gases in waters, the development of Fungi, the comparative purity of different waters, methods of softening hard waters, and the deterioration of waters by passing through metal pipes. The chapter is of great value, not only from a chemical but also from a sanitary point of view.

The third chapter of this section contains papers on the purification of foul water. These enquiries were made at the request of the Government, at a time when (in 1859) the Thames was "a black, seething, and stinking canal, its sluggish waters being carried backwards and forwards by the tide between London and Westminster; and the stench in the Committee-Rooms of the Houses of Parliament became so unbearable as to render necessary the filtration of the outer air through cloths wetted with solution of chloride of lime." Afterwards a Royal Commission was appointed to inquire how the contamination of rivers by sewage and refuse matters can best be prevented or avoided altogether.

The fourth chapter gives an account of some miscellaneous work in connection with Applied Chemistry. The papers relate to the making of artificial milk; the influence

of atmospheric pressure on the burning of time fuses; on the gases existing in solution in well-waters; on the analysis of sea-water; and (1877) on the transport of solid and liquid particles in sewer gas.

The third section, and rest of the book, is devoted to researches in Physical Chemistry. Chapter I. describes a number of experiments which were made between 1859 and 1868 on "The Influence of Atmospheric Pressure on Combustion." The research had its origin in an ascent of Mont Blanc, and for the first time a night was spent on the very summit of the mountain. Some candles were burnt on the summit, and it was noticed that although the rate of combustion was the same as at Chamounix, the intensity of the light emitted was much less. On examining further into this question the author was led to deduce the following law:—"The diminution in illuminating power is directly proportional to the diminution of atmospheric pressure." A further set of experiments proved that many luminous flames do not contain solid particles. Thus the flame of hydrogen or carbonic oxide becomes strongly luminous if it be caused to burn under a pressure of from 10 to 20 atmospheres. It was, moreover, ascertained that a hydrogen flame which when burnt in oxygen, under a pressure of 3 atmospheres, gave 1 to 2 units of light, under a pressure of 12 atmospheres gave no less than 100 units.

The second chapter contains memoirs on the spectra of gases and vapours. The experiments were carried out in conjunction with Mr. Norman Lockyer, in 1861, and resulted in the discovery of the fact that the hydrogenous solar atmosphere, or chromosphere, possesses an extremely low density, and that hydrogen, nitrogen, and magnesium give simpler spectra when their temperature and density are reduced.

The third chapter of this section is "On the Source of Muscular Power." Fick and Wislicenus proved, in 1865, that muscular power is to a great extent produced by the oxidation of non-nitrogenous substances, such as fat. Frankland determined to put the matter beyond dispute by determining the amount of potential energy locked up in muscle, and its chief products of oxidation—urea, uric acid, and hippuric acid. A number of Tables are given in the memoir, showing the amount of actual energy developed by 1 grain of various articles of food when oxidised in the body. These Tables show that 0·55 lb. of fat will perform the work of 1·15 lbs. of cheese, 5 lbs. of potatoes, 1·3 lbs. of flour or pea-meal, or of 3½ lbs. of lean beef. The following conclusions were drawn from the author's results, coupled with those of Fick and Wislicenus:—

1. "A muscle is a machine for the conversion of potential energy into mechanical force.
2. "The mechanical force of the muscles is derived chiefly, if not entirely, from the oxidation of matters either contained in the blood or deposited around the muscular fibres, and not from the oxidation of the muscles themselves.
3. "In man the chief materials used for the production of muscular power are non-nitrogenous; but nitrogenous matters can also be employed for the same purpose, and hence the greatly increased evolution of nitrogen, under the influence of a flesh diet, even with no increase of muscular exertion.
4. "Like every other part of the body, the muscles are constantly being renewed; but this renewal is scarcely perceptibly more rapid during great muscular activity than during comparative quiescence.
5. "After the supply of sufficient albumenoid matters in the food of man to provide for the necessary renewal of the tissues, the best materials for the production both of internal and external work are non-nitrogenous matters, such as oil, fat, sugars, starch, gum, &c.
6. "The non-nitrogenous matters of food which find their way into the blood yield up all their potential energy as actual energy; the nitrogenous matters, on the other hand, leave the body with a portion (at least one-seventh) of their potential energy unexpended.
7. "The transformation of potential energy into muscular power is necessarily accompanied by the production of heat within the body, even when the muscular power is exerted externally. This is doubtless the chief, and probably the only, source of natural heat."

The final chapter of the section and of the book is on climate, and contains various memoirs on this subject, written between 1861 and 1877. The ideas contained in the first of these, "On the Physical Cause of the Glacial Period," have since been almost entirely abandoned by the author; but he still retains his ideas as to the ultimate fate of the world. He believes that in course of time, when the ocean has been absorbed into the cavities created by the cooling of the interior of the earth, the latter will become as the moon, a mere sterile waste. The second short paper is on the formation of ground ice; and the third relates to the operation of solar temperatures at Davos during the winter of 1873-74. Davos is a small village, situated in a valley 5352 feet above the sea, in Canton Graubingen, Switzerland. On December 21st the mercurial thermometer with blackened bulb *in vacuo* showed 44° C. in the sunshine at 10 a.m., and 45° C. at 2.50 p.m.; at Greenwich, on the same day, the blackened bulb thermometer showed 9·3° C. at 9 a.m., and 21·9° C. at noon and 3 p.m. On another occasion a plain mercurial thermometer, with a black glass bulb, placed in a box lined with padded black cloth and covered with plate-glass, registered 105° C. at 2 p.m. The author attributes the peculiar winter climate of Davos—(*a*) to its elevation above the sea, which secures greater transcalency in the atmosphere; (*b*) thick and permanent snow, which reflects the solar heat, and prevents the communication of warmth to the air, and consequently the production of winds; and (*c*) a sheltered position favourable for receiving both the direct and reflected rays. In a paper which is a continuation of the preceding a number of determinations of solar intensity are given, and it is shown that solar intensity at the surface of the earth is independent of the sun's altitude. With a clear sky the intensity is sometimes greater in Norway 4° south of the Arctic Circle than under the Equator with a nearly vertical sun. Two short notes, one on the Radiometer and the other on Halos, conclude the volume.

Without doubt the most valuable portion of Professor Frankland's work to the general community is that which relates to potable waters and to artificial illumination; the most interesting portion to the chemist is the account of the discovery of numerous organic compounds. The book is many-sided in its interest, and both to student and master it will be found of increasing value. Although abounding in facts, and some of them very complex facts, the style is excellent, and the book is most readable. It has also the advantage of a good index and of a few good illustrations. We trust the example of Prof. Frankland will be followed, and that other investigators will publish an account of their researches in a collected form and with all necessary explanations.

The Chemist and Druggists' Diary for 1878.—This useful annual, which has now reached the tenth year of its age, in addition to the usual Diary, contains a large amount of information useful to the pharmaceutical chemist. For instance, there is an excellent article on County Court process, in which a number of practical directions for suing small debtors are conveyed in plain, every-day language. A dictionary of chemical and pharmaceutical synonyms is the fullest compilation of the kind we have yet met with, and may be consulted with equal profit by the scientific chemist as well as the pharmacist.

CORRESPONDENCE.

ILLUMINATING POWER OF BENZOL, &c.

To the Editor of the Chemical News.

SIR,—In his letter (CHEMICAL NEWS, vol. xxxvii., p. 61) Dr. Dittmar, criticising two papers of mine which he had never seen, asserts (1) that I *claim credit* for having pointed out in 1852 that hydrogen, carbonic oxide, and marsh-gas contribute nothing to the luminosity of coal-gas, and that the only constituents of value were benzol, ethylene, propylene, butylene, and acetylene. (2) That Bunsen in 1857 did not know of the existence of benzol in coal-gas, and that as I came "fresh from Bunsen" in 1852, and have added nothing to what I had learned from my master, it followed that I also could not know of the existence of benzol in coal-gas until in 1876 I was informed of that fact by Berthelot, and had seen the *proof* of it by Dr. Dittmar.

The practice of criticising papers from inner consciousness is, in this country at least, not a common one, and the result of your correspondent's attempt is not encouraging. If Dr. Dittmar will read the paper by Mr. Thorne and myself (when it is printed) he will find the following to be the only sentence to which his first assertion can have any reference:—"As early as the year 1852 it was pointed out by one of us that hydrogen, carbonic oxide, and marsh-gas practically contribute nothing to the light of coal-gas, and that the only constituents of this gas having any substantial value as light-giving agents are those hydrocarbons which combine with fuming sulphuric acid.—*Mem. of Manchester Lit. and Phil. Soc.* 2nd series), vol. x., p. 71."

So far from *claiming credit* for pointing out in 1852 that H and CO give no light Dr. Dittmar will find, if he will take the trouble to consult my paper of that year, the following statement:—"It has always been maintained that H and CO possess no illuminating power, and that the light emitted by coal-gas is due to light carburetted hydrogen (marsh-gas), olefiant gas, and other hydrocarbons." What I did in 1852 was to distinguish sharply for the first time between the illuminating and non-illuminating constituents of coal-gas. Before that year marsh-gas had always been considered as one of the luminiferous constituents. Thus, Mr. John Leigh, the Chemical Adviser to the Corporation Gas Works in Manchester, and one of the best authorities on the chemistry of coal-gas, wrote in 1851*—"There remain as constant ingredients of the gas, as at present manufactured, hydrogen, light carburetted hydrogen, olefiant gas, volatile hydrocarbons, carbonic oxide, and a little nitrogen; and of these the olefiant gas, volatile hydrocarbons, and light carburetted hydrogen (marsh-gas) alone contribute to illumination." When, in 1849, I obtained absolutely pure marsh-gas by the action of water upon zinc-methyl, I was surprised at the non-luminous character of its flame: again, in 1851, I observed, in my investigations on the manufacture of gas, that the illuminating power of coal-gas was not lowered by the substitution of hydrogen for marsh-gas; and, lastly, by sinking an iron tube through the peat of Chatmoss, near Manchester, I found that the natural marsh-gas which flowed abundantly through this iron tube gave, when burnt as a fishtail flame, scarcely more light than hydrogen. I brought up bags of the gas to London, and showed its non-luminosity to a large audience at the Royal Institution.

Dr. Dittmar's second assertion is equally devoid of foundation, for since the discovery and isolation of benzol in the liquid deposited from compressed gas by Faraday in 1825, and its subsequent extraction from coal-tar, the presence of benzol in coal-gas has, I presume, been known to all chemists. I cannot remember when I did not know it; and Mr. Leigh, in the paper just quoted, gives benzol with the formula $^{*}C_{12}H_6$ in a tabular list of the constituents of coal-gas. The assertion that Bunsen did not know it in 1857 is too preposterous for comment. From the notes of my lectures on technical chemistry, delivered at Owens College in the session 1853-54, I copy the following:—"Constituents of purified gas are H, CH_2 (marsh-gas), CO, gases and vapours having the formula $^{*}C_n H_n$, and vapours $C_n H_{n-6}$. . . . Vapours of the formula $C_n H_{(n-6)}$, benzole, toluole, cumole. These are hydrides of radicals of the phenyl series. Being highly carbonaceous they emit great light, as is seen by passing H through benzole." It is therefore evident that we do not owe our knowledge of the presence of benzol in coal-gas either to M. Berthelot or Dr. Dittmar. Neither has the latter furnished us with any additional proof of its presence, unless we are to consider as proofs such sentences as the following, quoted from his paper (CHEMICAL NEWS, vol. xxxvi., p. 145):—"It is true there *is* room for a little benzol." "These results render it highly probable that the light value of a coal-gas depends far more on the proportion of benzol than on the proportion of olefines contained in it. This, however, has nothing to do with the question on hand." "After these experiences I *felt convinced* that, although coal-gas as it comes out of the retort *cannot help* containing a considerable proportion of benzol, only very little of this vapour will survive the subsequent processes of purification." "Wishing very much to determine the exact ratio in the gas between the benzol and the olefines, I tried very hard to find out a quantitative method for their separation from each other, but I did not succeed." "The last substance I tried was non-vulcanised india-rubber, and if I may trust a few preliminary trials it *does seem* to have the power of abstracting the benzol from a gas without condensing *much* of the ethylene." If vague impressions and convictions like these are to be accepted as proofs then farewell to the reputation of chemistry as an exact science.

Lastly, Dr. Dittmar has given no quantitative determinations of the illuminating power either of benzol or of any other constituent of coal-gas, and I therefore fail to see that his paper anticipates, in any way whatever, the quantitative results communicated to the Chemical Society by Mr. Thorne and myself.—I am, &c.,

E. FRANKLAND.

Royal College of Chemistry,
South Kensington Museum, Feb. 11, 1878.

* *Memoirs of the Lit. and Phil. Soc. of Manchester*, vol. ix., (and series) p. 265.

ON THE MOTIONS OF CAMPHOR ON THE SURFACE OF WATER.

To the Editor of the Chemical News.

SIR,—By some means I overlooked Mr. Casamajor's letter in the CHEMICAL NEWS, vol. xxxvi., p. 285, until last week, or I should have noticed it earlier.

I am sorry to have to dissent from nearly every one of Mr. Casamajor's statements, and especially from the statement implied in the following question:—"Does it really matter whether one person or twenty persons have written that these motions are not due to electricity, and whether the idea that they are 'has been more than once taken up and abandoned?'"

If it were usual in science to ignore the results and opinions of our predecessors (of Volta and of Faraday, for example, in electricity), science would soon come to a standstill, and every question of human interest would have to be discussed again *ab ovo*.

Naphthalene *does* rotate on the surface of water; but being insoluble in cold water and only slightly soluble in hot, the water must be raised to 90° or 100° F., and then the fragments rotate briskly enough.

There is no state or condition of weather which prevents the gyration of the camphor fragments. If the water and

* C=6.

the vessel be chemically clean the camphor always rotates on the surface of water; most briskly, however, in fine clear weather, when the evaporative force is strong. In reviving the electrical theory in order to explain a few facts, and neglecting the surface-tension theory which embraces all the facts, numerous and diversified as they are, seems to me to be unphilosophical.

I referred Mr. Casamajor's two letters contained in the CHEMICAL NEWS, vol. xxxvi., pp. 191, 285, to Professor Van der Mensbrugghe, the author of the surface-tension theory, of the camphor motions, &c., and the following is the substance of his reply:—

A glass rod acts quite differently from a stick of resin. A glass rod or tube, whether electrified or not, arrests the motions of the camphor, because, when plunged into the water, the fragments near it are repelled all round; whereas a stick of resin will often produce an effect of attraction, and renew the surface in proportion as it is plunged deeper.

Van der Mensbrugghe has established this principle: that every contracting liquid surface heats and diminishes in tension, while every expanding liquid surface cools and increases in tension. Hence, if we plunge into water on which the camphor fragments are moving a clean rod of any material capable of being wetted, the capillary curve formed round it repels the fragments, and the layers, more or less saturated with camphor, become crowded together, whereby the differences in tension around the fragments are got rid of, or at least become insufficient for the continuation of the motions. On the other hand, if we plunge into the water a stick of sealing-wax or of a body that is not wetted, a depression is formed, and hence a renewal of the surface round each fragment, and consequently a greater or less tendency to motion, supposing the fragments to be already at rest.

It may be added that if the gyrations are stopped by the plunging in of a body that is wetted, they become, on the other hand, more rapid by withdrawing it, because the surface is thereby renewed by the impulse given to the fragments, and the more so in proportion as the wetted solid had been plunged deeper. In general, every process which augments or renews the surface increases the tension; and inversely, whatever leads to a diminution or heaping up of surface, diminishes the tension.

I trust that, after studying the foregoing details, Mr. Casamajor will alter, if not his opinion, at least his mode of speech, which is not altogether in the spirit of scientific chivalry.—I am, &c.,

C. TOMLINSON.

Highgate, N., February 11, 1878,

FEES.

To the Editor of the Chemical News.

SIR,—Mr. George Whewell, in last week's issue of your journal, referring to an analytical department recently instituted in connection with a trade journal (similar to those in connection with certain Continental publications), complains that a chemist should "do the work for less than half the usual fees." It will perhaps be sufficient to point out that no such statement is made in the article which your correspondent quotes from the *Textile Manufacturer*. The offer there made is from the proprietors of the journal to its subscribers, and has no connection with the arrangement between the journal and the chemist who does the work, although an ambiguity of language has caused Mr. Whewell to take it in the latter sense. There is nothing in the words quoted by Mr. Whewell to prevent the chemist getting *double the usual fees*, and the difference made between subscribers and non-subscribers ought, I think, to have prevented misconception on Mr. Whewell's part. As a matter of fact, the chemist in question knew nothing of the arrangement which your correspondent complains of until he saw it in type. On the general question of chemists' fees I may say that I think the present state of things unsatisfactory in many respects besides those touched on by Mr. Whewell, and I entirely agree with him in hoping the Institute of Chemistry will be able to place the matter on a basis more acceptable to professional chemists and to the general public.—I am, &c.,

THE CHEMIST REFERRED TO.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 1, January 7, 1878.

On Persulphuric Acid, a New Oxy-Acid of Sulphur.—M. Berthelot.—The author has obtained a new oxy-acid of sulphur, the persulphuric, corresponding in composition to the permanganic and perchromic acids, and whose existence is conformable to the analogies drawn from a comparative study of the sulphates, the chromates, and the manganates. It may be obtained in the pure anhydrous state by causing the electric effluve, at high tension, to act upon a mixture of sulphurous acid and oxygen, in equal volumes and absolutely dry. Concentrated sulphuric acid, under the same conditions, combines neither with oxygen nor with ozone. Persulphuric acid takes its rise also, though in a state of solution, during the electrolysis of concentrated solutions of sulphuric acid, under which conditions it has been hitherto confounded, either with oxygenated water or with that imaginary substance which has been called antozone. The same compound is also formed, but in a dissolved state, if a solution of oxygenated water is cautiously mixed with sulphuric acid, either concentrated or diluted with a quantity of water less than 1 equivalent. But combination does not ensue when the sulphuric acid is previously mixed with 2 equivalents of water, or more. In all these cases a part of the oxygenated water remains. It is probable that persulphuric acid is produced also in various other circumstances, as when concentrated sulphuric acid acts at a low temperature upon alkaline or metallic peroxides and other oxidising agents. Persulphuric acid is prepared with the author's concentric tube-apparatus described in the *Annales de Chimie et de Physique* (5e Série, xii., p. 463). After boiling for eight to ten hours the surfaces of the annular space are covered with little drops of a thick and adhesive liquid. Sometimes this liquid even spreads over the surface of the glass in a thin iridescent layer. When exposed to a temperature near 0° C. it forms sometimes indistinct granular crystals; sometimes in slender, flexible, transparent needles, several centimetres in length. In its general appearance it resembles anhydrous sulphuric acid, but the latter may be distinguished by its opacity, and by forming much finer, shorter, and less lamellar crystals. Persulphuric acid possesses a considerable vapour tension, which, at the temperature of 10°, rises to several centimetres. It is also displaced readily by spontaneous sublimation in the tubes which contain it. It often, however, remains liquid, or forms merely confused crystals. Nevertheless its analytical composition remains the same, not being sensibly affected by the accidental presence of some traces of water, of nitric or nitro-sulphuric acid derived from nitrogen, or of saline compounds due to action on the glass, which, however, suffice to hinder or modify the crystallisation. These impurities increase with the alterability of the glass and with the proportion of nitrogen, conditions against which it is necessary to guard. The composition of persulphuric acid may be established either

synthetically or analytically. When the reaction is concluded we may extract the residual gas with the mercurial pump, measure and analyse it, and compare its volume to that of the original mixture. The volume of the residue should be one-eighth that of the original gaseous mixture. Four volumes of sulphurous acid combine with three volumes of oxygen to form persulphuric acid. The compound may be analysed by opening one of the lateral points of the tube over a titrated solution of stannous chloride. The latter is immediately aspired by reason of the decrease of internal pressure due to the combination of the two gases; it is partially oxidised, and its loss of strength—estimated by means of pure permanganate of potassa—gives the weight of oxygen absorbed. The sulphuric acid in the liquid is then determined as sulphate of baryta. In two specimens the excess of oxygen was found respectively 8·23 and 10·00, the sulphuric acid being 83·4 and 94·1. The composition is S_2O_7, with which a number of analyses, performed in various manners, agree. Persulphuric acid may be preserved for several days at a temperature bordering on 0°, but in about a fortnight it shows signs of spontaneous decomposition. The aqueous solution is destroyed rapidly. The solution in sulphuric acid, though more stable, gradually gives off oxygen, and at the end of six weeks is completely destroyed. Persulphuric acid heated over a flame is at once decomposed into oxygen and anhydrous sulphuric acid. In presence of air it gives off dense fumes, and is converted into hydrated sulphuric acid at the expense of the aqueous vapour in the atmosphere. It dissolves in concentrated sulphuric acid without loss of oxygen, and the solution may be then diluted with water without immediate decomposition. Even after the lapse of twenty-four hours the strength of such a solution is not found to have been sensibly changed. If platinum sponge is added to the sulphuric solution, whether concentrated or dilute, gaseous oxygen is at once evolved, especially if heat is applied. Persulphuric acid converts sulphurous acid into sulphuric acid; but if it has been previously dissolved in a large quantity of concentrated sulphuric acid, it yields with sulphurous acid a notable proportion of hyposulphuric acid. Persulphuric acid dissolves in water with effervescence, due to the escape of oxygen, and gives off dense fumes. A portion, however, from one-fourth to one-fifth, remains for some time undecomposed in solution. With baryta-water a part of the oxygen escapes at once, whilst sulphate of baryta is precipitated, another part of the acid forming barytic persulphate—a soluble salt, which is rapidly decomposed into oxygen and barytic sulphate. Persulphuric acid, in the cold, oxidises neither acid solutions of arsenious acid nor those of oxalic acid, in which respect it resembles oxygenated water. From this compound it is distinguished by the fact that it neither forms perchromic acid nor reduces potassic permanganate. It can co-exist in solution either with oxygenated water or with ozone. Sulphur forms with oxygen a series of definite compounds, increasing in the following proportions:—

S_2: O (unknown; analogous to Cu_2O).
„ O_2 (hyposulphurous acid).
„ O_3 (unknown; analogous to Mn_2O_3).
„ O_4 (sulphurous acid).
„ O_5 (hyposulphuric acid).
„ O_6 (sulphuric acid).
„ O_7 (persulphuric acid).
„ O_8 (unknown: analogous to Os_2O_8).

This series expresses all the possible molecular types of the simple compounds which oxygen forms with other elements. The extreme limit, in most of the known cases, is reached by the acids which contain 7 equivalents of oxygen, such as the perchloric, permanganic, &c. These super-oxygenated acids offer a remarkable analogy in their physical and chemical properties, amounting in some cases to isomorphism. They constitute a true chemical type, RO_7, in which 7 equivalents of oxygen are associated with the most various elements. It is worthy of remark that the properties of the type are derived from the oxygen, and not from the oxidised element. They exist in the combination itself, and not in either of its constituent elements taken singly. The author is pursuing the study of the super-oxygenated acids of other elements.

On Certain Novel Modifications of the Telephone—M. Breguet.—A small plate of sheet-iron, quite analogous to that of Bell's telephone, is placed in contact with the end of an ordinary black-lead pencil, which presses gently upon the central part of the plate. The pencil and the plate are each connected by wires to the two ends of the wire of the coil of a Bell's telephone, the magnetised rod of which is replaced by a rod of soft iron. A battery of ten Leclanché elements is interposed in the circuit. When, on speaking, the plate of the apparatus is set in vibration, the end of the lead-pencil undergoes a series of modifications in its contact with the plate, but without contact being ever actually broken. These modifications show themselves as variations in the resistance of the circuit at the point of contact itself, and consequently by variations in the intensity of the permanent current of the battery. The current accordingly produces alternations of attraction and non-attraction in the electro-magnet of the receiving-apparatus, which act in the ordinary manner of Bell's apparatus.

Density of Liquid Oxygen.—R. Pictet.—M. Dumas appears to have found by calculation that the density of liquid oxygen, liquid or solid, should be equal to that of water. M. R. Pictet arrives at the same result experimentally. By the action of polarised light upon a jet of liquefied oxygen, solid particles were observed, probably minute crystals of oxygen.

Researches on the Intra-cellular Alcoholic Fermentation of Vegetables.—A. Muntz.—The author has experimented upon entire plants placed in an atmosphere of nitrogen. Very appreciable quantities of alcohol were detected, whilst similar plants kept as a check in ordinary air showed not a trace.

On the Inversion and the Alcoholic Fermentation of Sugar caused by Mould.—U. Gayon.—Not all moulds are capable of inverting sugar. *Penicillium glaucum* and *Sterigmatocystis nigra* rapidly produce this effect, whilst *Mucor mucedo*, *M. circinelloides*, *M. spinosus*, and *Rhizopus nigricans* are perfectly inert.

MISCELLANEOUS.

The Chemical Society's Research Fund.—We gave last week a list of the grants just made from the Research Fund of the Chemical Society. We are glad to state that since making these grants the fund has been increased by the following donations and subscriptions received from the Alkali Manufacturers' Association. The donations, amounting to £229, are from:—

Charles Tennant and Co.	£45
J. and L. Pattinson and Co.	35
R. Bealey and Co...	15
Roberts, Dale, and Co...	5
James Muspratt and Sons	35
A. G. Kurtz	50
Henry Baxter..	25
C. J. Schofield	5
Thomas Walker	9
D. McKechnie	5

The following are the annual subscriptions, to be continued for five years:—

Gaskell, Deacon, and Co.	£11	14
Chance Brothers	4	0
The Netham Chemical Co..	4	0
W. Pilkington and Son	7	0
James McBryde and Co.	3	0
W. Gossage and Son	4	10
Watson, Kipling, and Co.	2	18

Amounting altogether to £37 2s.

THE CHEMICAL NEWS.

VOL. XXXVII. No. 952.

ON DYER'S CHEMICALS.

By J. MARZELL.

(Continued from p. 56.)

DIPHENYLAMIN, $(C_6H_5)_2=NH$.

THIS base can be produced—(1.) By dry distillation of rosaniline and its phenyl derivatives, of leucaniline, and of melaniline.* (2.) By heating aniline with one of its salts to 220° to 250° C.†

$$C_6H_5NH_2+C_6H_5NH_2,S'=(C_6H_5)_2NH+NH_3S'.$$

Naturally, only the latter method could be used from an industrial point of view, and already in 1866 Ch. Girard and De Laire,‡ took patents in this direction for manufacturing that body on a large scale. The proportions for mixing aniline with its hydrochlorate vary. In the patent they take by preference 3 parts of aniline to 1 part of its hydrochlorate, for the reason that a surplus of aniline facilitates the reaction. In practice,‖ a charge-adjusted to an apparatus of a certain size consists of 140 lbs. of hydrochlorate and 100 lbs. of aniline.

The apparatus for this has a capacity of about 5600 c.″ = about 16″ of D., and 27″ of H., capable of holding about 20 gallons. The vessel is of cast-iron, and proved for a high pressure. It is set in brickwork, having a fireplace beneath, but an arrangement is made, that the flame cannot play directly on the vessel. The apparatus is enamelled inside. The enamel is either laid on the body itself or a separate thin cast-iron and enamelled vessel—adjusted to the inner form of the pressure-tube—is inserted, the tight joining being effected by filling up the space between with melted lead. That arrangement is better in this way, that, if the enamel gets damaged, by replacing this vessel by a new one kept in reserve, the damage can be repaired without causing any delay or interruption of work. The cover of the pressure-pot is fastened by bolts and screws, and, besides a pressure-gauge and safety-valve, it is provided with a kind of man-hole, allowing the apparatus to be charged without taking off the cover. In choosing the pressure-gauge it must be remembered that it has to stand a high heat. The safety-valve is regulated in a way that it blows off at a pressure of 5 to 6 atmospheres (75 to 90 lbs.).

The action takes place in the following manner:—

$$\left.\begin{matrix}C_6H_5\\H\\H\end{matrix}\right\}N+\left.\begin{matrix}C_6H_5\\H\\H\end{matrix}\right\}N,HCl=\left.\begin{matrix}C_6H_5\\C_6H_5\\H\end{matrix}\right\}N+NH_4Cl.$$

After putting in the mixture—filling up the vessel to about two-thirds of its volume—the man-hole is closed, and fire applied. It is heated up till the safety-valve just begins to blow off, and the temperature—now about 265° to 280° C. inside the pot—is maintained for about twelve hours. A steady regular temperature is of much advantage for the reaction and yield.

A very disagreeable point in this process is a secondary reaction, taking place during the operation, and spoiling the yield considerably. The ammonia liberated in the reaction acts upon the formed diphenylamin in the following manner, reducing it to aniline:—

$$\underbrace{\left.\begin{matrix}C_6H_5\\C_6H_5\\H\end{matrix}\right\}N}_{\text{Diphenylamin.}}+\underbrace{NH_3}_{\text{Ammonia.}}=2\underbrace{N\left\{\begin{matrix}C_6H_5\\H\\H\end{matrix}\right.}_{\text{Aniline.}}$$

The only precaution against it is to let out the formed NH_3 from time to time by lifting the safety-valve or opening a cock especially added to the apparatus for this purpose. Though a small quantity of aniline vapours escape with the ammonia, in a well directed operation the loss is so very inconsiderable that it is not worth while to complicate the apparatus by the application of a condenser.

Girard and De Laire* give a sketch of an apparatus connected with a refrigerator and a condenser. They at first heat up for about two hours with the cock of the refrigerator opened, till the temperature has risen to about 215° to 220° C. Then the cock is shut, and the reaction finished under pressure, the ammonia and aniline being gathered in the condenser. The yield is said to be in this case 50 to 70 per cent of the aniline used.

It is to be remarked that pressure is not an indispensable condition, and that diphenylamin can be got as well by heating the mixture at common air-pressure for some time to the boiling-point. But as in this way the operation requires much more time, and the yield is not nearly so satisfactory as in the first case, this method could not be adopted in industry.

If the operation is finished the apparatus is allowed to cool down, the safety-valve opened, and the cover taken off. The half-solid mass is taken out, brought into a wooden tank, and treated with about 140 lbs. concentrated hydrochloric acid. Heating up takes place (40° to 60°), and a solution is formed containing hydrochlorate of diphenylamin, hydrochlorate of aniline, and free hydrochloric acid. Whilst well stirred, and supplying a slight heat by means of direct steam if necessary, 60 to 80 galls. of water are added, and after intimately mixing the liquid is allowed to settle for at least twelve hours.

The hydrochlorate—like all salts of diphenylamin—being very unstable is decomposed into diphenylamin and free hydrochloric acid, whilst the hydrochlorate of aniline remains in solution in the acid liquor. The diphenylamin gathers on the surface, and solidifies in cooling. It is taken off and washed, at first with hot water, then with a slight alkaline solution, and finally with hot and cold water till it is completely neutral; afterwards it is pressed and dried, best at common temperatures. According to the low fusing-point of the diphenylamin (54° C.) even a small heat, in the drying rooms, can be supplied only with great precaution. Good ventilation is the only thing to assist and to quicken the process.

The crude product obtained in this way is always coloured, and has to pass an operation of purifying. The usual way is to re-distil it. The stills are cast-iron vessels with a flat bottom, the cover fastened by screws. They are heated up by direct fire, and are set in brickwork like the pressure-tube described above.

The diphenylamin distils at 310° C., the temperature in the still varying between 310° and 350° C.

Another method—but causing more inconvenience without giving better results—is to extract the diphenylamin instead of washing the impurities out, and to separate it from the non-diluted bodies by filtering. As solvent, either benzol or petroleum (the best distilling between 80° and 150° C.) are taken. In evaporating them off, the diphenylamin remains as the residue; it is pressed and distilled.

A method, perhaps to be used with great advantage, is the sublimation with superheated steam. Only a heating up to the fusing-point is wanted in this way, and therefore a smaller loss from carbonisation to be foreseen than at a temperature up to 350° C.

The diphenylamin obtained in this way represents a

* A. W. Hofmann, *Ann. Chem. Pharm.*, cxxxii., p. 100.
† Girard, De Laire, and Chapoteaut, *Comptes Rendus*, lxiii., p. 91.
‡ English Patent, No. 1093.
‖ Girard and De Laire, Derivés de l'Houille, Paris

* Derivés de l'Houille.

yellowish white body of an agreeable aromatic smell. The chemically pure body crystallises in white needles. It is nearly insoluble in water. Alcohol, ether, benzol, petroleum, and aniline dissolve it in great quantities. With the mineral acids and acetic acid it forms salts, which are decomposed on addition of water. In this case the diphenylamin separates in yellow oily drops, solidifying on cooling.

ANALYSIS OF CANE-SUGAR ASH.

By Dr. WALLACE, Glasgow.

The following analysis of the ash of cane-sugar may be interesting to those engaged in the manufacture or refining of sugar. The sugar contained an unusually large proportion of ash (1·38 per cent), and I understand that the canes from which it was made were grown near the sea coast in Demerara, or the adjacent Dutch colony. So far as I can ascertain the cane-juice was treated with lime only.

Potash	29·10
Soda	1·94
Lime	15·10
Magnesia	3·76
Sulphuric anhydride	23·75
Phosphoric „	5·59
Carbonic „	4·06
Chlorine	4·15
Peroxide of iron	0·55
Alumina	0·65
Silica	12·38
	101·03
Deduct O=Cl	0·93
	100·10

THE FORMATION OF CRYSTALS OF CALCIUM OXALATE IN THE URINE AFTER ITS DISCHARGE.

Communicated by Prof. ALBERT B. PRESCOTT.

The importance attributed by medical authorities to the occurrence in the urine of calcium oxalate in crystals, irrespective of the time or conditions transpiring between the discharge of the urine and its examination, led to some investigation in the chemical laboratory of this institution as to the effect of time in production of these crystals. All the examinations here reported upon were made by M. E. Post.

The samples of urine were taken both from persons in health and from the sick. In every case *the urine of twenty-four hours* was taken together, and examined, soon after the last portion of it was passed, for all deviations from the normal standard, the specific gravity being taken and a careful search made for crystals of calcium oxalate. Specimens containing the crystals in question at this first examination were rejected; all other specimens were set aside at ordinary temperature (in May and June), the twenty-four hours' urine standing in one bottle, and being examined each day thereafter for the oxalate, until oxalate crystals appeared or the experiment was abandoned with a negative result for the time stated. The results for forty-four specimens *not showing oxalate at first examination* are given below. The specific gravity was taken by weighing in about half the cases; Vogel's urinometer being used for the others. It will be seen that in about 68 per cent of the cases, crystals of oxalate were formed after the first examination, the average period of appearance of the oxalate being at 5th day.

No.	Sp. Gr.	Principal Deviations.	Appearance of Oxalate
1	1·028	Urates precipitated	Appeared 7th day
2	1·012	Excess of phosphates	„ 5th „
3	1·014	Normal	„ 12th „
4	1·030	Urates crystallised	„ 6th „
5	1·019	Uric acid crystallised	„ 3rd „
6	1·018	Urates crystallised	„ 13th „
7	1·020	Excess of epithelium	„ 11th „
8	1·015	„ „ „	None to 20th „
9	1·023	Sugar	Appeared 4th „
10	1·023	Epithelium, urethra	None to 30th „
11	1·015	Epithelium, pus, blood, casts, and albumen	„ 28th „
12	1·018	Pus, tubular casts	„ 28th „
13	1·031	Urates visible	Appeared 2nd „
14	1·030	„ „	„ 2nd „
15.	1·024	Normal	„ 2nd „
16	1·019	„	„ 2nd „
17	1·023	Excess of urea	„ 3rd „
18	1·016	Normal	„ 4th „
19	1·029	Urates crystallised	„ 26th „
20	1·022	Normal	„ 3rd „
21	1·029	„	None to 22nd „
22	1·016	Uroxanthine	„ 22nd „
23	1·017	Normal	Appeared 3rd „
24	1·032	„	„ 2nd „
25	1·032	„	None to 18th „
26	1·012	Excess of epithelium	Appeared 3rd „
27	1·010	Deficiency of urea	„ 2nd „
28	1·022	Normal	„ 2nd „
29	1·026	„	None to 24th „
30	1·022	„	„ 24th „
31	1·019	„	Appeared 4th „
32	1·019	„	None to 24th „
33	1·025	„	Appeared 4th „
34	1·020	„	None to 18th „
35	1·017	Excess of epithelium	Appeared 2nd „
36	1·021	Normal	„ 3rd „
37	1·025	„	„ 3rd „
38	1·027	Excess of epithelium	„ 5th „
39	1·025	Normal	„ 2nd „
40	—	„	„ 3rd „
41	1·030	Uric acid, crystallised	„ 6th „
42	1·024	Normal	None to 25th „
43	1·024	„	„ 22nd „
44	—	„	„ 12th „

After the day when the crystals of oxalate appeared there was little apparent change in the number and size of the crystals until the urine became alkaline, when they began to diminish, and, in the three cases which were daily examined, the crystals of oxalate after a few days of alkalinity wholly disappeared.

A few determinations of *the quantity of uric acid* were made before and after the appearance of oxalates, but the experiments were too few to be of much value. Of seven trials only four samples showed oxalate crystals on standing; of these, three gave less uric acid after the appearance of the oxalate than before, and one gave the reverse of these results. The uric acid was determined by its crystallisation, and the estimation of the crystals, washed with 5 c.c. of alcohol, by standard solution of permanganate. The quantities were as follows:—

	Urine.	Before Oxalates Appear.	After Oxalates Appear.
1	812 c.c.	0·1218 grm. uric acid	0·0324 grm. uric acid
2	600 „	0·2568 „ „	0·1620 „ „
3	815 „	0·0880 „ „	0·1597 „ „
4	530 „	0·6148 „ „	0·3086 „ „

It is designed hereafter to investigate the effect of temperature upon the production of calcium oxalate crystals; also, to experiment with quantitative methods for the oxalate to be applied before and after appearance of the crystals.

University of Michigan,
November 14, 1877.

THE APPLICATION OF AMMONIUM SULPHOCYANIDE IN VOLUMETRIC ANALYSIS.

By J. VOLHARD.

Determination of Silver.

IN a nitric solution of silver to which a soluble ferric salt has been added a permanent redness does not appear on the gradual addition of a dilute solution of ammonium or potassium sulphocyanide until all the silver has been thrown down as a sulphocyanide. If we know how much of the sulphocyanide solution is required to precipitate a known weight of silver we can determine volumetrically the quantity of silver present in any acid argentic solution, the ferric salt serving as an indicator. For the preparation of the standard solution the author uses ammonium sulphocyanide, though Lindemann prefers the potassium salt; both, in dilute solution, are permanent. But the ammonium salt is less frequently contaminated with chlorides, which interfere greatly if present in more than mere traces. The solution may be conveniently made of such a strength that 1 c.c. indicates 1 centigrm. of silver. The weighed quantity of the salt is dissolved in water, and diluted in a graduated flask so far that 7·5 grms. (or 8 grms. if the salt appears very damp) may be contained in each litre. For the precipitation of 1 grm. of silver 0·704 grm. of pure ammonium sulphocyanide is requisite; 0·5 grm. of chemically pure silver is then weighed out, dissolved in 8 to 10 c.c. of pure nitric acid of sp. gr. 1·20, and, after the complete solution of the metal, the nitrous acid is expelled by boiling or prolonged heating on the sand-bath, and the solution is allowed to cool. It is then diluted with 200 c.c. of water, and 5 c.c. of a cold saturated solution of ammonia-iron alum are added. If the colour of the ferric salt is perceptible a little pure colourless nitric acid is added till it disappears. The sulphocyanide solution is then added from a burette. At first a white precipitate is produced which remains suspended in the liquid like silver chloride, rendering it milky. On the further addition of sulphocyanide each drop produces a blood-red cloud, which quickly disappears on agitation. As the point of saturation is reached the silver sulphocyanide collects in flocks, and the liquid grows clearer without becoming perfectly limpid as long as a trace of silver remains in solution. As soon as all the silver is precipitated the flocculent precipitate quickly deposits and the supernatant liquid becomes quite clear. The sulphocyanide solution is added by drops till this point is attained, and till a very faint light brown colour appears in the liquid, which does not vanish on repeated agitation. The colour is most easily perceived if the liquid is held, not up to the light, but against a white wall turned away from the window.

For a repetition of the experiment it is convenient to use a silver solution of known strength. For this purpose 10 grms. of pure silver are dissolved in nitric acid in a lure flask, the nitrous acid is expelled, the liquid is allowed to cool, and diluted up to the volume. For use 50 c.c. are taken with a pipette. If the above-mentioned proportions are preserved for 0·5 grm. silver or 50 c.c. of the silver solution, somewhat less than 50 c.c. of the sulphocyanide solution will be required, whence the needful dilution can be calculated. If 48·5 c.c. sulphocyanide have been used, then to every 48·5 c.c. of the solution 15 c.c. of water must be added.

The solution is perfectly permanent, even on being kept for two years. The silver solution must have a decidedly acid reaction from free nitric acid, which it is quite unnecessary to neutralise. Nor is it important that the proportion of acid in different experiments should be approximately equal. It is, however, essential for the constancy of the results that the ferric salt should be in large excess, and should be used approximately in one and the same proportion to the total volume of the fluid. It must also be remembered that the colour of ferric sulphocyanide is destroyed by nitrous acid at common temperatures, and by nitric acid on the application of heat. Hence follows the necessity of completely expelling all nitrous acid, and of allowing the liquid to become cold before the operation is begun. The nitric acid used in this process should be kept in the dark.

Titration of Silver in Presence of Other Metals.

Copper.—The proportion of copper in an alloy may reach 70 per cent without in the least affecting the accuracy of the process. Beyond this limit the recognition of the final reaction is somewhat doubtful, since after the precipitation of the silver the liquid is rendered opaque and discoloured by the formation of black copper sulphocyanide. The only remedy in such cases is to add a known weight of pure silver to the alloy so as to reduce the proportion of copper below 70 per cent, as is done in Gay-Lussac's process.

Mercury.—In presence of this metal silver cannot be titrated with sulphocyanide solution. This defect is of little consequence as mercury is readily expelled.

Palladium renders the titration of silver with a sulphocyanide inaccurate, this metal appearing in the result as silver. This is an important circumstance from a technical point of view, since palladium, though frequently present in silver, occurs in very small quantities.

As regards other metals soluble in nitric acid and found along with silver in alloys and ores, lead, cadmium, thallium, bismuth, zinc, iron, and manganese are without influence. The recognition of the final reaction in solutions strongly coloured by salts of cobalt or nickel requires some practice. At first a few drops of sulphocyanide will always be added in excess. It is then recommended to titrate back with a solution of silver, when the pure colour of the cobalt or nickel will appear so suddenly and distinctly, that it will conversely be easy to seize the exact point when the colour of the solution is modified to a yellowish brown by the addition of the colour of ferric sulphocyanide. When this change of shade has been observed four or five times by titrating backwards and forwards with exactly corresponding solutions of silver and of sulphocyanide such a certainty in the recognition of the final reaction will be attained that there can be no doubt as to the addition of a half drop more or less.

The presence of tin, antimony, and arsenic does not interfere with the accuracy of the process.

A comparison of the results of this method as compared with those obtained by cupellation and by Gay-Lussac's method shows that it is not inferior in accuracy. In comparison with Gay-Lussac's process it has the advantage that the preliminary cupellation is dispensed with, and the end of the reaction is more distinctly recognised.

Determination of the Halogens.

For these determinations two standard solutions are required, one of silver and one of sulphocyanide. For the former 10·8 grms. of chemically pure silver are dissolved in pure nitric acid (sp. gr. 1·20) in a litre flask, and after the expulsion of nitrous acid made up to 1000 c.c. A solution of ammonium sulphocyanide prepared as above-directed is adapted to this silver solution, so that when equal volumes of both are mixed in presence of a ferric salt there may appear a colouration just perceptible. Both solutions are of course decinormal.

The determination of chlorine is conducted as follows:—The weighed sample of chloride is dissolved in 200 or 300 c.c. of water, mixed with 5 c.c. of the ferric solution, and so much nitric acid as may cause the colour of the ferric salt to disappear. A measured quantity of silver solution, rather more than necessary to precipitate all the chlorine, is then added, and without filtering off the silver chloride the sulphocyanide is then dropped in with the burette, taking care to ensure the immediate mixture of the drops with the fluid by constant agitation. As soon as the solution takes a pale yellowish brown colour, which after agitation remains permanent for ten minutes, all the silver is precipitated, and the liquid contains no per

ceptible trace of chlorine in solution. The number of the c.c. of silver solution added less the number of c.c. of sulphocyanide solution consumed multiplied by 0·00355 gives the weight of the chlorine in grammes.

If the amount of the chlorides is totally unknown so that we do not know approximately how much silver solution is to be added, the sample is mixed with ferric solution and nitric acid as before, and whilst the silver solution is gradually run in from the burette a drop of sulphocyanide solution is added from time to time. As long as there is still chlorine in solution the redness produced disappears but slowly and gradually, but as soon as the colour produced by a new drop of sulphocyanide disappears immediately on agitation, and the liquid appears of a pure milk-white, enough silver has been added, and the titration is completed as directed above. Of course the quantity of sulphocyanide added at first or during the introduction of the silver must also be deducted from the silver solution. It is therefore well to drop in the sulphocyanide with the same burette which is used for the completion of the titration.

Bromine.—The dilute solution of the bromide is mixed with 5 c.c. of iron solution and a little nitric acid, and strongly coloured with a few drops of sulphocyanide solution. The silver solution is then added from a burette till complete decolouration is produced, and the titration is completed with sulphocyanide, which is added till the liquid takes a faint but permanent pale brown colouration. The number of c.c. of silver solution added less the number of c.c. of the sulphocyanide solution consumed, multiplied by 0·0080, gives the weight of the bromine present in grammes.

Iodine.—The iodine is dissolved in 200 or 300 parts of water, preferably in a glass with a well-fitting stopper, and the decinormal solution of silver is added from a burette. As long as iodine remains in solution, the silver iodide remains in a state of milky suspension, and even persistent agitation does not clear the solution. When, by the gradual addition of the silver solution, all the iodine has been thrown down the precipitate becomes collected in flocks, and as soon as a minimum excess of silver is present the liquid appears to coagulate, and on shaking the flocculent silver iodide separates from the limpid liquid. By this phenomenon the conclusion of the reaction is indicated. From one-tenth to two-tenths of a c.c. of the silver solution must then be superadded, the flask stoppered, and shaken for some minutes. In this manner any soluble iodide which has been entangled in the precipitate is converted into silver iodide. Iron solution to the extent of 5 c.c. is then added along with a little nitric acid, and sulphocyanide solution is added with the burette till the liquid is very distinctly coloured. On shaking this colour disappears. Small quantities of sulphocyanide are then added with alternate agitation, till a slight but permanent colour is obtained. The number of c.c. of silver solution consumed less that of c.c. of sulphocyanide used and multiplied by 0·0127, gives the weight of the iodine in grammes.

Determination of the Halogens in Organic Compounds.

When the organic matter is previously destroyed by ignition with lime, or, preferably, with carbonate of soda and saltpetre, the application of the volumetric process is too simple to require a special description.

Recognition and Determination of the Halogens in Presence of Sulphocyanides.

Silver sulphocyanide is destroyed by heating with concentrated sulphuric acid, and is readily dissolved by the addition of a little nitric acid. If the sulphuric acid is diluted with half its bulk of water it does not attack silver chloride, whilst its action upon silver sulphocyanide is scarcely lessened. If it is therefore required simply to detect or determine chlorine in presence of sulphocyanides, the solution of the latter, acidified with nitric acid, is precipitated with excess of silver solution. The precipitate filtered and drained is placed along with the filter in a boiling flask and covered with pure sulphuric acid of the strength above-mentioned. If, on heating, it becomes black and clotty a few drops of nitric acid are carefully added. The silver chloride if present in quantity remains substantially undissolved; if but little chlorine was present complete solution may ensue, but on dilution with water silver chloride is deposited, free from silver sulphocyanide.

In order to detect and determine bromine or iodine in presence of sulphocyanides, the latter are destroyed by fusion with saltpetre and sodium carbonate. It must be remembered that the reaction is extremely violent, and that unless a large proportion of the carbonate is used deflagration may ensue. It is preferable to introduce the mixture gradually into the ignited crucible. The sulphocyanide is mixed with 10 to 15 parts of dry sodium carbonate, and the mixture, having been dried by gently heating in a porcelain crucible and pulverised afresh, is gradually added to 8 to 10 parts of melted saltpetre.

Separation of Silver Chloride and Iodide.

Silver chloride, when treated with ammonium sulphocyanide in an ammoniacal liquid, is readily and completely converted into silver sulphocyanide, while silver iodide remains untouched.

Cyanogen.—Silver cyanide is converted into sulphocyanide by hydrosulphocyanic acid so rapidly that dissolved silver cannot be titrated with sulphocyanide solution in presence of silver cyanide. But if the silver cyanide be precipitated from a given quantity of prussic acid by an excess of silver solution, there is no difficulty in titrating the excess of silver in the filter with sulphocyanide solution. For the determination of hydrocyanic acid, however, the author prefers Liebig's original process, using a centinormal silver solution. He points out that dilute solutions of hydrocyanic acid are much more volatile than had been supposed.

Determination of Copper.

Copper is precipitated as a sulphocyanide of constant composition in presence of powerful reducing agents, such as sulphurous acid. From the solution of a copper salt, not too acid and mixed with sulphurous acid, the copper is completely precipitated by ammonium sulphocyanide. A gentle heat promotes the formation and separation of the precipitate. The quantity of the copper is found by precipitating with a known excess of sulphocyanide solution, and then determining with silver solution, after addition of ferric salt and nitric acid, the quantity of sulphocyanide remaining in solution.

The standard solutions of silver and sulphocyanide are decinormal as used for the determination of the halogens. The sulphurous acid does not interfere with the distinctness of the final reaction if ferric salt has been added in sufficient quantity.

For the titration of mercurial compounds the process is less exact and is not recommended by the author.

The oxidising power and value of dilute permanganate solutions can also be determined by means of a solution of sulphocyanide titrated with silver.—*Liebig's Annalen der Chemie.*

Gallium.—At the *Académie des Sciences* on Monday last M. Lecoq de Boisbaudron exhibited a bar, a sheet, and several crystals of the new metal, *Gallium*, which is harder than iron, yet melts at under the heat of the finger, its freezing-point being at about 30°. It is proposed to use it for a thermometer going up to red-heat. 5000 kilogrms. of ore had to be worked down to get 60 grms. of metal. It will now be possible to investigate its physical properties. It adheres to glass, and is very brittle; the colour is nearly that of steel; and the crystals are octohedra.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

February 16, 1878.

Professor W. G. Adams, President, in the Chair.

The following candidate was elected a Member of the Society:—Mr. G. H. West, M.A.

Dr. Lodge read, for Mr. H. F. Morley, M.A., a paper "*On Grove's Gas Battery.*" After referring to the views of M. Gaugain and Mr. Grove himself with regard to the cause of the action of this apparatus, the author proceeded to describe an elaborate series of experiments he has recently made in order to ascertain the circumstances by which it is regulated. It would be impossible to give a clear account of them in a short space, but some of his conclusions are as follows:—The whole of the current is due to dissolved gas, and if n be the distance of the level of the liquid from the top of the plate in the H tube, and

$$E = \frac{CR}{1000},$$

C being given in galvanometer readings, and R in ohms, he finds that, approximately, $(1+n\,a)C = b+ne-(c+nd)E$, where a, b, c, d, and e are constants. The electromotive force is not constant, but rises with the resistance. The current is greater in proportion as the gas present in the elements is less; and, finally, the current appears to vary directly with the pressure.

Mr. S. C. Tisley then described the "*Harmonograph*," specially referring to its use for drawing pairs of curves for the stereoscope. This, the latest form of his pendulum apparatus, is capable of giving a very great variety of curves, for, in addition to rectangular vibrations, parallel and elliptic motions can be combined by its means. In the older form of apparatus each pendulum moves on the other as a centre, whereas in the instrument described they are independent. One pendulum carries at its upper end a table, which can be caused to rotate by clockwork if required. The whole is supported on a kind of gimbal joint formed of two pairs of knife edges at right angles, so arranged that each vibration can take place either on one or the other, or the two can be so combined as to give a circular motion; or, again, the pendulum can be caused to vibrate in any given plane. The second pendulum vibrates in the plane in which the two hang, and carries at its upper end an arm terminating in a pencil over the table of the other pendulum. A very ingenious adjustment renders it possible to raise or lower the bob of the second-named pendulum during its motion. If two pens be attached, about 2¼ inches apart, instead of the single one usually employed, and two curves be traced, they are not precisely similar, and when viewed in a stereoscope they are found to give the well known appearance of solidity to the figure. It was further shown that by gradually changing the relative motions of the pendulum it is possible to impart to the curve many of the forms observed in biaxial crystals in the polariscope.

Mr. F. J. M. Page then exhibited the action of the telephone on a capillary electrometer. The construction of Lippmann's electrometer, as modified by Marey, was first explained, and the meniscus of the mercury in the capillary tube was thrown on the screen by the electric light. The delicacy of the instrument was shown by passing a current of 1-1000th of a Daniell, which caused a distinct movement of the mercury. Resistances of 500 ohms and 1-50th ohm gave approximately the same deflection, so that, in practice, the instrument may be considered to be independent of resistance, in addition to which it possesses the great advantage of portabillty, and its indications are almost instantaneous. To illustrate the use of the electrometer for physiological investigations, a frog's heart was connected by non-polarisable electrodes with the instrument: each beat of the heart caused a considerable movement of the mercury column. A telephone was now connected. On pressing in the iron plate the mercury moved, and on reversing the wires the movement was seen to be in the opposite direction. On singing to the telephone each note produced a movement, but the fundamental note of the plate, as well as its octaves and fifths, had the greatest effect. On speaking, the mercury oscillated continually: some letters of the alphabet had scarcely any effect, and the *w* was especially curious, producing a double movement. Reversing the wires did not alter the character or *direction* of these movements. The same effect was observed when the telephone was in the primary and the electrometer in the secondary coil of a Du Bois Reymond's induction coil. In conclusion, Mr. Page showed the contractions produced in a frog's leg. On inserting under the sciatic nerve two platinum wires coupled with the binding-screws of a telephone, and talking to this instrument, violent contractions ensued.

In the course of the discussion which followed,

Prof. Graham Bell expressed himself as highly gratified at the results of Mr. Page's experiments. He has made very many attempts to ascertain the strength of the current produced by the human voice in vain, but considers the present method will in all probability give some most valuable results. He was quite unable to account for the fact that the motion of the mercury took place *from* the opening, but this seems to depend on conditions not yet determined.

Mr. Wilson then exhibited for Prof. S. P. Thompson a "*Lantern Slide Galvanometer*" for showing the deflections of the needle to an audience. It consists of a coil of insulated copper wire wound on a flat bobbin, within which a needle is balanced on a horizontal axis. This needle carries a long needle of aluminium, which traverses a semi-circular divided photographic scale, and as this is transparent the index can be projected on to the screen. The whole is enclosed between two glass plates.

CORRESPONDENCE.

AMMONIA IN FILTERED WATER.

To the Editor of the Chemical News.

Sir, Kindly permit a few words on your correspondents' remarks on the above subject (Chem. News, vol. xxxvii., pp. 9, 19, 30, 38). I think I may confidently assert that I never found in water, which had been filtered through spongy iron, anything like 7·30 parts of ammonia per million, when the unfiltered water was free from it. Did the filter to which your correspondent refers have fair play? Filters are frequently placed close to ill-ventilated water-closets; there may be a leakage of gas near them, or they may be tampered with in various ways from ignorance or mischief. In one instance a complaint reached me that a filter did not work satisfactorily. By degrees I found out that this filter had been employed for clarifying turbid wine, and when, naturally, the water afterwards had a disagreeable taste, hydrochloric acid was poured into the spongy iron to cleanse the filter! After such experience chemists ought to be careful before drawing general conclusions from exceptional results.

There is little doubt that ammonia is formed in the filter by the combination of atmospheric nitrogen and of hydrogen, resulting from the decomposition of water by spongy iron, but I am satisfied that this is an extremely minute item. I have left distilled water in contact with spongy iron for three months, and even then it contained only 1·54 parts of ammonia per million. Moreover, if that source of ammonia were not so insignificant, how is it that the filtered water is not always so highly charged with ammonia. On the contrary, by referring to Tables

(p. 220) of the "Sixth Report of the Rivers Pollution Commission," you will find that the filtered water is not unfrequently quite free from ammonia. In my opinion the latter is mainly derived from the decomposition of nitrates and of nitrogenous organic matter.

It was, I suppose, a slip of the pen if one of your correspondents asserted that water filtered through spongy iron, and natural waters from ferruginous strata were under the same influence. I cannot see how any one of the explanations of the formation of ammonia by spongy *metallic* iron would hold good in the case of such natural water.

Lastly, as to the significance of ammonia in water, chemists will, I think, agree that even such a quantity as 7·30 parts per million is in itself harmless. However, we look with suspicion upon a natural water containing any large quantity of ammonia, because the latter serves to a certain extent as an indicator of decomposing animal matter in the water: I say to a certain extent, because the indication thus afforded is very frequently misleading. Thus, in the Report above referred to, we find in the Table (p. 74) two shallow well-waters, one of which is free from ammonia, but contains 2·42 org. carbon, 1·15 org. nitrogen, and 31·02 nitrogen as nitrates and nitrites per million. The other sample, with 0·17 part of ammonia, shows only 0·38 of org. carbon, 0·07 of org. nitrogen, and 23·07 of nitrogen as nitrates and nitrites per million. However this may be, in the spongy iron filter the water passes solely through inorganic materials, which cannot in themselves contain the elements of organic contamination. The presence of ammonia in the filtered water *must* therefore be due to some such reaction as herein mentioned, and thus evidently loses any significance which we may attribute to it when dealing with a natural water. —I am, &c.,

GUSTAV BISCHOF.

Analytical Laboratory, 4, Hart St., Bloomsbury, London, W.C., February 11, 1878.

ESTIMATION OF PHOSPHORUS IN IRON AND STEEL.

To the Editor of the Chemical News.

SIR,—I am afraid, from the report which has appeared, that my remarks (CHEM. NEWS, vol. xxxvii., p. 68) on Mr. Riley's paper at the Chemical Society were not perfectly understood. The long time (two or three days) required for the complete precipitation of Mr. Riley's magnesian phosphate is undoubtedly owing to the large amount of citrate of ammonium present; but this large proportion of citrate of ammonium is actually necessary, from the considerable amount of iron present, and cannot therefore be described as "too much."

When the solution of phosphoric acid contains no citrate, tartrate, or oxalate, precipitation by magnesia is complete in half an hour, according to the experiments of E. M. Dixon. Thus, though the molybdic method when properly carried out—by removal of chlorides and re-solution of the molybdic precipitate—is longer in its earlier stages than the citric acid method, it is far shorter in its later stages, and I should doubt if, on the whole, it would occupy more time.

Mr. Riley may be quite right in condemning the present use of the molybdic method by metallurgic analysts, but that the method when properly employed is most accurate does not at the present day admit of doubt.—I am, &c.,

R. WARINGTON.

Harpenden, February 16, 1878.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

SIR,—The Report of the General Meeting of the Institute (CHEM. NEWS, vol. xxxvii., p. 57) furnishes the information for which I asked in my last letter.

From that Report we learn that of the first batch of "more than 300 chemists" elected as Fellows of this Institute, only 153 have as yet accepted the Fellowship; and that of the second batch of 160 Fellows and 43 Associates elected by the Council, only 65 have accepted their election. In other words, only about half of those chemists whom the Council elects have been prevailed upon to accept their election—which constitutes a preliminary *fiasco*.

Persons who, like myself, look upon the Institute with disfavour, will also be amused at the President's account of the difficulties which his Company encountered at the Board of Trade, and how—in order to get registered—the Institute submitted to the explicit abandonment of the power of granting "any certificate of proficiency or qualification."

How, after such abandonment, the Institute is to be regarded as standing in the same relation to the profession of Chemistry as that occupied by the Colleges of Surgeons and Physicians towards Medicine, passes my comprehension. Perhaps the four newly-elected Censors may explain this difficulty.—I am, &c.,

J. ALFRED WANKLYN.

February 9, 1878.

COPPER EXTRACTION.

To the Editor of the Chemical News.

SIR,—Noticing Mr. Wilson's communication upon the above subject (CHEM. NEWS, vol. xxxvii., p. 65), I offer the following remarks upon it:—

1. The process is a very old one. G. D. Mease, in January, 1861 (No. of patent, 42), advocated the employment of waste manganese liquor. In July, 1861 (No. of patent, 1869), Edward Haeffely put forward a process substantially the same as described by Mr. Wilson on p. 65. He describes the process in his specification very minutely. He states that the burned ore is to be placed in vats, "the whole arrangement being similar to that commonly employed for lixiviating soda-ash." "The liquid employed is the residue from the manufacture of chlorine when muriatic acid and manganese have been used, generally thrown away as useless." The solution is to be diluted if necessary, and placed in a vat where "vat waste from the manufacture of soda-ash is added, so as to precipitate the whole of the copper as sulphuret," "which is collected on a sand- or other filter, washed with water," dried, and "converted into sulphate or otherwise disposed of, as may be desired." In March, 1866 (No. of patent, 753), W. F. Deane obtained provisional protection for the following:—"Treating the roasted pyrites with the residual liquor arising from the production of chlorine gas, and obtaining the copper in the form of sulphuret," "which last result is oxidised, and brought into the form of sulphate of copper."

2. There are so few places now where the chloride of manganese solution can be called a waste liquor, and even these few must gradually die out.

3. That even could this still liquor be obtained, used as it would be for the free acid it contains, it would not be an economical proceeding. Native stills, when worked properly, are run off with 80 per cent of the acid in combination containing only from 3 to 4 per cent of free HCl. Now, as tower salts (as the crude HCl is called) contain 28 per cent HCl, a ton of manganese liquor would only be worth ¼th of a ton of spirits of salts. Now tower salts can be bought at Widnes for 6s. 8d. per ton in boats, and this less 1s. 8d. for filling and loading is 5s., or making the value of still liquor for this purpose, on the supposition that all the free acid in it is as active as that in tower salts (which it is not) at 8½d. per ton—a price which would scarcely pay to transfer it from one vat to another.

4. The sulphuric acid in the still liquors would form

sulphate of lime with the soda-waste; and though it may be argued that this would be insoluble, yet on a manufacturing scale my experience of sulphate of lime has not been a favourable one, especially in acid solutions. There would also be cinders, silica, &c., to deal with.

5. By not calcining with salt, a great deal more copper would be left insoluble than by the present mode of working. It may be inferred that some of the copper sulphide would be oxidised and dissolved by reason of the presence of iron perchloride which is present in native still liquor; but this reaction is not new. It was patented by Gossage in March, 1859 (No. of patent, 594).

6. Mr. Wilson recommends that the pyrites should be crushed, ground, and baked, and states that it has the advantage of costing no more than breaking the large lumps with hammers. This is contrary to all experience, for when broken by Blake's crusher the cost is less than 6d. per ton of pyrites, whereas pyrites *smalls* generally cost 4s. per ton for labour, steam, fuel, and wear and tear, for grinding and baking into cakes. Every shilling expended upon the burnt pyrites means at least really 30s. per ton upon the copper produced.

7. With reference to the last paragraph of paper on page 65, it may be stated that the process (Haeffely's) is well known to most copper manufacturers, and has been carried on extensively by Messrs. Harrison, Blair, and Co., of Bolton, for many years, for the manufacture of sulphate of copper, with modifications of their own found necessary by practical working; and if I should be asked why a manufacturer should continue to work a process unless much superior to that generally employed, I may add that, when capital is invested in plant, to write that off is often a serious bar to the introduction of a new process which only pays slightly better. To those interested in new copper processes the following specifications may be of some use:—

Newton, No. 9748, May, 1843; Bankart, No. 10,805, August, 1845; Birkmyre, No. 11,966, November, 1847; Longmaid, No. 13,630, May, 1851; Bouch, No. 174, January, 1858; Gossage, No. 594, March, 1859; Henderson, No. 2900, December, 1859; Spence, No. 3154, December, 1860.

—I am, &c.,

GEORGE E. DAVIS.

Barton Arcade, Manchester,
February 16, 1879.

ON THE MOTIONS OF CAMPHOR, &c.

To the Editor of the Chemical News.

SIR,—I sent a correction last week, which seems to have arrived too late, to the effect that the specimen of naphthalin on my shelf, which was procured from Morson some years ago, rotates briskly on hot water, but not on cold. A friend has sent me a specimen of pure naphthalin which does not rotate either on hot or cold water, doubtless from being more insoluble than the other specimen; nor does the addition of a few drops of spirits of wine to the water assist it in rotating.

A curious practical application of the camphor motions has lately been recommended. Among the infinite resources of fraud the practice has lately been adopted of oiling wheat and other kinds of grain, for the purpose of increasing the weight. Cheap rape-oil is used, and it is said that fourpenny-worth of oil will increase the apparent value of a ton of wheat from 20s. to 25s., but I confess that I do not quite understand how. But the point is, what is the readiest mode of detecting the presence of the oil? It is recommended to scrape a few fragments of camphor on the surface of water, and then add a few of the grains. If they have been oiled they will at once arrest the camphor motions; if not oiled, the gyrations will continue.

I recommended this method of detecting traces of grease or of fixed oil in water many years ago, and it is described in Hardwich's "Manual of Photographic Chemistry," seventh edition, 1864, p. 111.—I am, &c.,

C. TOMLINSON.

Highgate, N., February 18, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences, No. 2, January 14, 1878.

Presence of Oxygen in Metallic Silver.—M. Dumas.—The author, after referring to the discussion which has recently taken place on the fundamental principles of the atomic theory, admits that there is another question which has the most important bearing upon the very nature of matter, and which still remains open. Whilst the equivalents of simple bodies when compared with that of oxygen do not exhibit any appreciable relation, we had formerly merely to take the equivalent of hydrogen for unity in order to find that the equivalent of carbon might be taken as 6, that of oxygen as 8, that of nitrogen as 14, that of sulphur as 16, of calcium as 20, of iron as 28, &c. The equivalents of elementary bodies seemed therefore represented by multiples of the equivalent of hydrogen by whole numbers. For those who believe in the unity of nature these experimental results gave great force to their opinion, and rendered it permissible to suppose that the reputed elementary bodies might result from the simple aggregation of similar molecules varying merely in number or in arrangement in each case. These results have been called in question. From a mere practical point of view chemists may content themselves with the notions on the weights of equivalents already acquired. Such, however, is not the case in a purely philosophical light, and it was necessary that experiment should decide whether the equivalents of simple bodies are or are not multiples of one and the same fundamental unity of whole numbers. In this discussion it is not useless to remember that we have never been deceived by the balance, the most perfect of all instruments, but often, on the other hand, by faults in calculation, and especially by involuntary errors as regards the purity of the substances employed. Berzelius, the creator of numerical chemistry, convinced (as he had the right to be) of the precision of his experiments, maintained their rigour to the third decimal. But it would suffice to refer to a vacuum the apparent weight of the bodies upon which he operated— a correction which he had neglected—in order to modify the last decimals of his figures. As concerns the gases all the determinations of density made in the first years of the century, compared with that of hydrogen, vary a little from the simple ratios which they ought to present. Oxygen ought to appear 16 times as heavy as hydrogen, nitrogen 14 times, carbonic acid, 22 times, &c. Experiment certainly gave results approximating to these numbers, but deviations were still present which ought not to have been met with. It had not then been observed that every gas collected over a liquid has lost its purity, and that in order to operate upon a pure specimen it should be conveyed directly from the generating apparatus to that where it is to be operated upon. When this modification was introduced, the weights of nitrogen, of oxygen, and carbonic acid for one and the same volume became, we may say, exact multiples of the weight of hydrogen by whole numbers. We put aside, for the moment, as of no importance, the question whether this unity should be hydrogen itself, or double its weight, that is, 1 or 2, since we have to do, not with absolute numbers, but with ratios.

May we not consider the following figures, determined by experiment, as expressing ratios in whole numbers :—

Hydrogen	1·00
Carbon	6·02
Lithium	7·02
Oxygen	8·00
Nitrogen	14·04
Sulphur	16·02
Calcium	20·01
Sodium	23·04

Is there not here the indication of a natural law? The irregulatities, even where greatest, may they not be ascribed to an imperfection in the experiment rather than to the constitution of the bodies in question? I have never ceased pursuing the thought that to determine the absolute ratios of weight between the equivalents it is necessary, not merely to take materials very pure, reactions very simple, and weights referred to a vacuum, but to employ, further, some precautions which have been overlooked. I think I may now add that when it is needful to carry precision to its utmost limit we cannot, in many cases, consider the weight of bodies as exact until they have been kept in a vacuum at an elevated temperature unless they no longer evolve anything, and until the barometer connected with the apparatus remains at its normal height. It is not sufficient for bodies to remain for a long time in a vacuum in the cold, or for a short time in heat, or to be heated to redness at the common pressure. This may be shown by an example. Among the compounds which have played a part in the determination of equivalents the chloride of silver figures in the first rank. By reason of its insolubility any soluble chloride may be transformed into chloride of silver with such facility that these reactions afforded a very general means for ascertaining the equivalents of the elementary bodies. Still, if we compare the various syntheses of chloride of silver we find differences absolutely inexplicable. Thus, for 100,000 of silver, we find, according to—

Berzelius	132·700	of chloride
Marignac	132·842	„
Stas	132·850	„
Dumas	132·870	„
Gay-Lussac	132·890	„
H. Rose	133·014	„

Among these numbers which is the correct one? No one will call in question the skill of the experimentalists. We must seek the causes of the discrepancy in the circumstances of the experiment, aad they seem to lie in the state of the metallic silver used for conversion into chloride. Our colleague, M. Debray, had at my request prepared 1 kilo. of pure silver, using the common procedure for melting and granulating this metal, *i.e.*, fusion with the addition of a little borax and nitre—a method pursued by most of the experimentators who have determined its equivalent, or made use of it in the determination of others. I placed this silver in a flask of glazed porcelain connected with a Sprengel pump. I heated the flask, and soon, the temperature having risen to 400° or 500°, gas was evolved, and continued to escape for six hours, being collected in tubes over mercury. The flask was kept at from 500° to 600°, but without exceeding a dull red heat. When the disengagement ceased all the gas remaining in the flask was drawn out, and the temperature raised to the fusion of the silver. No further escape of gas took place. When the flask was cool a well-crystallised button of silver was found. The interior of the flask was partially covered with globules of distilled silver, but there was not a trace of that yellow tint which shows the formation of silver silicate. The button when carefully cleaned had the specific gravity 10·512, consequently higher than that generally ascribed to silver. The gas given off was pure oxygen, amounting in quantity to 57 c.c. at 0°, and 0·76 per kilo. of silver. Hence the silver experimented upon contained 999·918 grm. of silver and 82 milligrms. of oxygen. Another kilo. of silver, into which small successive portions of nitre were thrown during fusion, was found to contain 226 milligrms. of oxygen, and only 999·774 grms. of real silver. It appears from these trials that in the very numerous experiments for the determination of equivalents which have been made with the intervention of silver the chemists who, having taken the necessary precautions for the purification of this metal, have granulated it after previous fusion in presence of borax, nitre, and air, have placed it in the proper circumstances for the absorption of oxygen in proportions varying from 50 to 200 c.c. per kilo. These quantities are calculated to exercise a notable influence upon the results deduced from the synthesis of silver chloride, or the very numerous experiments which have served for determining the weights of elements by finding the quantity of silver necessary for the decomposition of their chlorides. The oxygen augments the apparent weight of silver employed, and diminishes the weight of the chloride obtained. The ratio of the chlorine to the silver is therefore necessarily altered. The results obtained by Marignac and Stas, or even by Berzelius, in place of the proportion 108:35·47 would give 108:35·50, as found by Gay-Lussac and the author, if the correction for the presence of oxygen were applied to their experiments. But there remain other objections to be raised before the problem of the numerical relations existing between the equivalents of simple bodies can be considered as solved. The conditions of this reciprocal action of oxygen and silver deserve a close examination. If the metal is heated to dull redness in a vacuum, a moment arrives when, all the gas present having been extracted, if the silver is fused and oxygen permitted to re-enter the apparatus, it is absorbed rapidly. The mercury re-ascends, and keeps at the height of 48 to 50 centimetres for entire hours, even at a temperature at which porcelain softens. We may thus determine the tension of the solution of oxygen in melted silver, or the tension of dissocia- of the compound, if we consider the product as a chemical combination. If the apparatus is allowed to cool the silver is solidified, and a sudden escape of oxygen takes place, but the metal, even in a vacuum, does not give off anything approaching to the quantity of oxygen absorbed. Thus, according to these experiments, silver which has absorbed oxygen does not lose it in the cold in a vacuum. At from 400° to 600°, in a vacuum the escape is rapid, but tends to cease above a cherry-red heat. When the silver softens, and especially when it melts, the phenomenon is reversed, and the absorption of oxygen becomes rapid. On solidification a quantity of the oxygen is lost, though considerable quantities are still retained. The experiments of Lucas, Chaudet, Gay-Lussac, and Graham have shown that silver possesses the power of dissolving oxygen, and of losing a part again on solidification. If this fact has not been taken into account in the delicate researches to which this metal has been devoted it is because the oxygen was supposed to have entirely escaped at the moment of solidification. The interesting researches of M. F. Le Blanc on the power which litharge possesses of dissolving oxygen on fusion, and losing it again on cooling, refer doubtless to a phenomenon of the same class.

Formation of Oxygenated Water, Ozone, and Persulphuric Acid during Electrolysis.—M. Berthelot.—Faraday first remarked that the electrolysis of dilute sulphuric acid yielded a volume of oxygen less than one-half that of the hydrogen simultaneously disengaged, and ascribed this phenomenon to the formation of oxygenated water. After having recapitulated the various explanations suggested by other chemists and physicists, the author maintains that the oxidising compound formed during electrolysis cannot be oxygenated water nor yet ozone. It is, further, only formed during the electrolysis of sulphuric solutions, a circumstance which points to the identity of the substance in question with persulphuric acid. The three bodies—oxygenated water, ozone, and persulphuric acid—may all be simultaneously formed during electrolysis, but in small quantity and in variable proportion.

Stability of Ozone.—M. Berthelot.—The speed of the destruction of ozone is so much the greater the richer is the gas. Ozone has no finite point of dissociatory temperature, which agrees with its endothermic formation.

Note in reference to the Report of the Last Session.—M. Pasteur.—The author complains of the manner in which M. Trecul has described his researches on moulds.

The Vibrations of Matter, and the Undulations of the Ether as probable consequences of the fact which serves as a basis for the Mechanical Theory of Heat.—M. Favé.—Not adapted for abstraction.

Liquefaction of Gases.—M. Cailletet.—The author enclosed in the tube of his pressure apparatus dry air deprived of carbonic acid, and refrigerated the upper part of the tube *only* with nitrous oxide. When the pressure had reached 200 atmospheres, small threads, doubtless liquid, were seen to flow down the lower part of the tube. Ether when flowing in a tube presents the same appearance. When these threads came in contact with the mercury below the refrigerant, the pressure was then increased to 255 atmospheres, when the liquid threads became more numerous and more distinct. At 310 the mercury was frozen, and was covered with hoar-frost, doubtless frozen air.

On Telephony.—M. Breguet.—M. Salet, inverting the application of the principle of Edison, has constructed a telephone founded on the varying conductibility produced by the contact between a piece of graphite and one or more points of metallic sponge. He has also experimented with various substances of but moderate conducting power, among others with gas-coke.

Investigation of the Ultra-violet Solar Spectrum.—M. A. Cornu.—These researches may be regarded as a continuation of Angström's memoir on the "Normal Solar Spectrum," and its extension beyond the visible portion, comprehending all the ultra-violet part of the spectrum. The first part of the paper relates to that portion of the ultra-violet spectrum observable with ordinary laboratory spectroscopes fitted with object-lenses and prisms of glass. It extends from the ray h' ($\lambda=410{\cdot}10$) to the ray O ($\lambda=343{\cdot}97$). The second part extends from O to the extreme ultra-violet observable with a spectroscope with lenses of quartz and a prism of Iceland spar. This limit correspond to the ray U ($\lambda=294{\cdot}80$). The author has succeeded in determining the wave-lengths of the rays O, P, Q, R, r, and S with direct solar light. The variable limitation of the ultra-violet part of the spectrum is due to atmospheric absorption, and its extent varies in the same ratio as the height of the sun above the horizon. At equal heights, however, the spectrum is much more extended in winter than in summer. Hence the absorption seems mainly due to the watery vapour in the atmosphere, which is much more abundant in summer than in winter.

Fertility of Volcanic Soils.—M. Truchot.—The author points out that Dr. Gavazzi, in treating on the same subject, has made no mention of the phosphoric acid present to a notable extent in such soils.

Liquefaction of Hydrogen.—Raoul Pictet.—The author obtained hydrogen by decomposing potassic formiate by potassa. The hydrogen thus escaped is perfectly dry, and the residue is not volatile. The pressure reached 650 atmospheres before becoming stationary. The cold was about $-140°$. On opening the cock the liquid hydrogen escaped with vehemence, marking a sharp hissing sound. The jet had a steel-blue colour, and was perfectly opaque for the length of 12 centimetres. At the same moment a rattling was heard like that made by hail when it falls upon the ground, and the hissing became transformed into a peculiar noise, resembling that made by a fragment of sodium thrown upon water. Almost immediately the jet became intermittent, and shocks were felt in the cock at each escape. During the first jet the pressure fell from 650 atmospheres to 370. After closing, it gradually fell for several minutes down to 215 atmospheres, and then slowly rose to 225, where it became anew stationary. On re-opening the cock the jet issued in so intermittent a manner that it became evident that the congelation of hydrogen had taken place in the tube. This hypothesis was demonstrated by the progressive escape of all the hydrogen when the pumps were stopped, and the production of cold arrested.

Justus Liebig's Annalen der Chemie, Band 190, Heft 1 and 2.

Hydrazin Compounds.—Emil Fischer.—A prolonged treatise, utterly incapable of useful abstraction.

Determination of Caustic Alkali in presence of Alkaline Sulphides and Carbonates.—This process is well adapted for the analysis of ball-soda. The weighed sample is ground up under alcohol till all the caustic alkali is dissolved, heat being applied if necessary, and to the cold concentrated solution CS_2 is added. The liquid is largely diluted with water; the alkaline sulphides and sulpho-carbonates are removed by the addition of a solution of lead or zinc, avoiding excess, when the caustic alkali may be calculated from the quantity of the xanthogenate found. For the determination of cupric salts no further preparation is needed than weighing, solution in water, and the addition of much salt of Seignette. If the solution is acid it is previously neutralised with sodium carbonate, and then titrated with a solution of xanthogenate of a known strength till the last signs of turbidity cease in the liquid. The approaching end of the operation is indicated by the disappearance of the greenish blue colour. The solution of xanthogenate of potassium is unfortunately not permanent.

Communications from the Laboratory at Greifswald.—These consist of a paper, by Dr. G. Heinzelmann, on certain derivatives of meta-disulpho-benzolic acid.

Relative Affinity of Oxygen for Hydrogen and Carbonic Oxide.—A. Horstmann.—If aqueous vapour is present before combustion the proportion of aqueous vapour formed by combustion is diminished, and the consumption of carbonic oxide promoted. On the other hand, the previous presence of carbonic acid causes the combustion of more hydrogen and less carbonic oxide.

Les Mondes, Revue Hebdomadaire des Sciences, No. 5, January, 31 1878.

Duter's Artificial Magnets.—M. Duter has exhibited magnets made by submitting circular plates of steel to the action of an electro-magnet terminating in a conical point applied to the centre of the disc. In these magnets the neutral line is circle of the disc, concentric with the ray—

$$\frac{R}{\sqrt{3}}.$$

Experiments with the Telephone.—A. Demoget.—If two telephones are placed in direct communication with the two wires of a Ruhmkorff's coil so as to close the currents of each of them by means of the wires, and if anyone speaks into either of the instruments, the second transmits the sounds as if the two telephones were in direct communication. If anyone speaks into a telephone in connection with the thick inducting wire the coil acts as if with a battery, although the currents are alternately inverted, and very feeble discharges are produced at the extremity of the induced wire on bringing them into contact with the tongue by means of two wires of fine copper. The voices of women and children are heard better with vibrating plates of 3 to 5 centimetres in diameter, and the voices of men with plates of 6 to 8 centimetres. If the gamut is sung into a telephone with a large vibrating plate the lowest notes are easily heard, whilst the higher

ones become less distinct. If the vibrating plate is small the case is reversed. At the end of a line two telephones may be placed in a double circuit, and if we speak or sing simultaneously into both the two voices are heard distinctly in a single telephone at the other extremity of the line.

Xylophilin.—This substance, the cause of the violet shade which certain vegetable membranes display on contact with hydrochloric acid, is a colourless substance, soluble in water and alcohol, found in more than 60 per cent of woody plants, and 30 per cent of herbaceous plants.

No. 6, February 7, 1878.

This issue, except the discourses pronounced at the funerals of M. Becquerel and M. Regnault, contains merely the proceedings of the Academy of Sciences.

Die Chemische Industrie, Vol. I., No. 1, January, 1878.

This new contemporary is the organ of the recently-founded association for promoting the interests of the chemical manufactures of Germany.

The present issue contains a paper by Dr. H. Gericke on the excise-duty on charcoal in Germany, with its bearings upon the chemical arts. R. Hasenclever contributes a paper on the soda manufacture of Germany, from which it appears that since the reduction of the duty in 1873 the production of soda has fallen from 58,000 to 42,500 tons yearly, whilst the imports have risen from 14,000 to 32,000 tons. He considers that the continental alkali works cannot withstand English competition without the aid of protective duties. The same writer gives an account of Thelen's apparatus for the concentration of lyes, saline waters, &c., which, however, cannot be usefully described without the accompanying illustration.

363*me Lettre-Causerie. Publication Scientifique Hebdomadaire.*

This issue contains a full account of the process of MM. Fremy and Feil for the manufacture of artificial minerals.

NOTES AND QUERIES.

Replacing Acids.—I should be glad if any of your correspondents could tell me a ready way of substituting H_2SO_4 for HCl and HNO_3 in combination) in solutions, on the manufacturing scale, without evaporating to dryness.—A SUBSCRIBER.

MEETINGS FOR THE WEEK.

MONDAY, 25th.—Medical, 8.
—— Royal Geographical, 8.30.
—— Society of Arts, 8. "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," T. Bolas, F.C.S.
TUESDAY 26th.—Civil Engineers, 8.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
—— Anthropological, 8.
WEDNESDAY, 27th.—Society of Arts, 8. "The Past, the Present, and the Future of the River Thames," J. B. Redman.
THURSDAY, 28th.—Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
—— Philosophical Club, 6.30.
—— Society of Arts, 8. "The Chemistry of Infection, or the Germ Theory of Disease from a Chemical point of view," C. T. Kingzett, F.C.S.
FRIDAY March 1st.—Royal Institution, 8. Weekly Meeting. "On the Deterioration of Oil Paintings," Dr. Leibreich, 9.
—— Archæological Institute, 4.
SATURDAY, 2nd.—Royal Institution, 3. "Carthage and the Carthaginians," R. Bosworth Smith, M.A.
—— Physical, 3. "On the Phonograph," W. H. Preece, C.E.

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 953.

ON THE ACTION OF SODIUM ON CHINOLINE AND LEPIDINE.

PRELIMINARY NOTICE.

By C. GREVILLE WILLIAMS, F.R.S.

IN a paper "On the Higher Homologues of Chinoline" * I mentioned that, on treatment with sodium, these bases yield a very beautiful substance, which communicates to silk a fine orange colour. I have lately repeated these experiments with sodium-amalgam containing 10 per cent of sodium.

When the amalgam is added to chinoline or lepidine the mixture heats, turns reddish brown, and at last solidifies. The addition of water causes a yellowish oil to separate. This oil, boiled with water and an acid, affords a deep reddish brown solution, which, on cooling, deposits crystals of a superb scarlet colour. In one case, where the chinoline had been purified by conversion into the chromate, the salt surpassed the finest vermillion in tint. The drying must be effected in the dark, as the crystals are altered in colour by light. The same may be said of silk or wool dyed with this substance.

A preparation made with chinoline, and boiled out with hydrochloric acid, gave on analysis—

Carbon	73·5
Hydrogen	5·6

The formula $C_{18}H_{14}N_2.HCl$ requires—

Carbon	73·3
Hydrogen	5·1

The substance would therefore appear to be the hydrochlorate of di-chinoline.

Lepidine was then treated, as described, with sodium-amalgam, and the resulting oil boiled with dilute nitric acid. The solution, on cooling, gave a crop of red crystals, which on combustion afforded the following numbers :—

Carbon	68·8
Hydrogen	5·7

The nitrate of di-lepidine, $C_{20}H_{18}N_2.HNO_3$, requires—

Carbon	68·8
Hydrogen	5·4

The subject is still under investigation.

Star Chemical Works, Fulham,
February 21, 1878.

ON DYER'S CHEMICALS.

By J. MARZELL.

(Continued from p. 76.)

ALCOHOLIC DERIVATIVES OF DIPHENYLAMIN.

METHYL-DIPHENYLAMIN.

To prepare this body, Girard and De Laire took patents in France (June 30, 1869)* and England (December 18, 1869).† Almost at the same time M. Bardy took a patent for this matter. The principal methods are the following :—

(1.) Action of $\left\{\begin{matrix}\text{iod-methyl}\\ \text{methyl-nitrate}\end{matrix}\right\}$ upon diphenylamin below 100° C. :—

$$\left.\begin{matrix}(C_6H_5)_2\\ H\end{matrix}\right\}N + ICH_3 = \left.\begin{matrix}(C_6H_5)_2\\ CH_3\end{matrix}\right\}N + IH.$$

(2.) Action of methyl-aniline upon hydrochlorate of aniline (Girard and De Laire) :—

$$\underbrace{N\left\{\begin{matrix}C_6H_5\\ CH_3\\ H\end{matrix}\right.}_{\text{Methyl-aniline.}} + \underbrace{N\left\{\begin{matrix}C_6H_5\\ H\\ H\end{matrix}\right.}_{\text{Aniline.}} + HCl = \underbrace{N\left\{\begin{matrix}C_6H_5\\ CH_3\\ C_6H_5\end{matrix}\right.}_{\text{M.-diphenylamin.}} + NH_4Cl.$$

(3.) Action of methyl-alcohol upon the anhydrate of the hydrochlorate of diphenylamin (Berthelot, Bardy).

(4.) Action of methyl-alcohol and hydrochloric acid upon diphenylamin (Ch. Girard).

Nos. 3 and 4 rest upon the action of methyl-chloride in *status nascendi* upon the diphenylamin. At a certain temperature the unstable hydrochlorate is decomposed into its ingredients, leaving the free hydrochloric acid able to operate upon the methyl-alcohol, yielding methyl-chloride—which immediately enters into reaction with the diphenylamin—and water —

$$\text{I. } CH_3OH + HCl = CH_3Cl + H_2O.$$

$$\text{II. } \left.\begin{matrix}(C_6H_5)_2\\ H\end{matrix}\right\}N + CH_3Cl = \left.\begin{matrix}(C_6H_5)_2\\ CH_3\end{matrix}\right\}N + HCl.$$

Even No. 4 does not require so high a pressure and temperature as has to be supplied in following No. 3.

In an enamelled autoclave, able to hold about 60 galls., and proved for a pressure of 600 to 750 lbs., 200 lbs. of diphenylamin, 136 lbs. of hydrochloric acid (1·2 sp. gr.), and 50 lbs. of methyl-alcohol are mixed, and heated up to about 200° to 250° C. for ten to twelve hours. The pressure generally does not rise above 150 lbs. The vessel is plunged into an oil-bath. If the reaction is over the whole is allowed to cool down, the tube opened, and the mass taken out. Brought into an enamelled iron tank, a hot solution of caustic soda is added in a slight excess. The crude methyl-diphenylamin, and the unattacked diphenylamin separare, and are taken off and distilled. The temperature wanted is about 290° to 300° C.

For purifying the distillate, it is put into an enamelled iron or wooden tank, and treated with about 230 lbs. concentrated hydrochloric acid; a slight heat supplied if necessary. In cooling, the HCl diphenylamin crystallises out, and is separated by filtering. To the solution containing the methyl-diphenylamin as hydrochlorate about 250 galls. of water are added, intimately mixed, and then the liquid allowed to settle for about ten hours.

The hydrochlorate of methyl-diphenylamin is decomposed. The free base gathering on the surface is digested, washed with a slight alkaline solution, and then with hot and cold water, and finally distilled. In this way a nearly colourless liquid is obtained, distilling between 282° to 286° C. The methyl-diphenylamin is only little soluble in alcohol, better in ether and benzol. Its salts are unstable, and are undecomposed by water.

ETHYL-DIPHENYLAMIN, $N\left\{\begin{matrix}C_6H_5\\ C_6H_5\\ C_2H_5\end{matrix}\right.$

This base is to be obtained in an analogous manner as the methyl derivative, with the only difference, that instead of methyl, ethyl alcohol (C_2H_5OH) has to be taken. It is an oily liquid, boiling between 295° to 300° C., easily soluble in ether and benzol. Its salts can be decomposed with water.

AMYL-DIPHENYLAMIN, $N\left\{\begin{matrix}C_6H_5\\ C_6H_5\\ C_5H_{11}\end{matrix}\right.$

Formed in an analogous manner as the foregoing, but higher temperature and pressure have have to be applied.

* "The Laboratory," i., 109.
* Attition an Brevet concernant la Diphenylamin.
† No. 3675.

Oily liquid, distilling between 335° to 345° C. Its basic character is nearly gone. Less soluble in alcohol than the methyl and ethyl derivatives. Benzol dilutes it in arge quantities.

Benzyl-diphenylamin, $N\begin{cases}C_6H_5\\C_6H_5\\C_7H_7\end{cases}$

This body can be obtained by action of benzyl-chlorure upon diphenylamin:—

$$C_7H_7Cl+\left.\begin{matrix}C_6H_5\\H\\C_6H_5\end{matrix}\right\}N=N\begin{cases}C_6H_5\\C_7H_7\\C_6H_5\end{cases}+HCl.$$

It is solid, soluble in alcohol, ether, and benzol, separating from these liquids in splendid crystals.

(To be continued).

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.*

By H. CARRINGTON BOLTON, Ph.D.

(Continued from p. 67).

Metals and Organic Acids.

11. That citric and tartaric acids dissolve iron and zinc, with evolution of hydrogen gas, is a well-known fact, stated in many handbooks of chemistry.†

Crommydis has recently taken advantage of the solubility of zinc in oxalic acid to prepare glycollic acid ($H_2C_2H_2O_3$), a reaction in which nascent hydrogen plays an important part.‡

In repeating and extending these experiments we have made the following observations: Iron, zinc, and magnesium dissolve readily in cold saturated solutions of citric, tartaric, oxalic, and malic acids, as well as with formic (sp. gr. = 1·060) and acetic acids (sp. gr. = 1·037), evolving hydrogen more or less freely; on heating, the action becomes violent. Magnesium is attacked by citric and other acids violently, the liquid becoming much heated.

A cold saturated solution of citric acid, diluted with half its volume of water, attacks zinc slowly in the cold; on boiling, hydrogen comes off freely and continues to do so after cooling for a long time; the disengagement of gas being slow but steady, and under favourable conditions lasting for twenty-four hours. If the solution becomes very concentrated, an insoluble citrate of zinc precipitates, soluble, however, in water.

Tartaric acid acts on zinc feebly in the cold; on boiling, solution ensues, and at the same time the hot liquid becomes milky from the formation of an insoluble tartrate of zinc; on cooling, the solution becomes clear and a precipitate settles.

Oxalic acid in concentrated solution attacks zinc in the cold immediately; but the action soon ceases, owing to the surface of the zinc becoming coated with a quite insoluble zinc oxalate; on heating to boiling, the evolution of hydrogen is resumed, but is again arrested in a short time from the same cause. On cooling, a fine precipitate forms.‖

Sulphides.

12. After experiencing the solvent power of organic acids described in the preceding section, we were prepared to discover many sulphides yielding to them, though we confess to surprise at finding this action taking place even in the cold. Such is the case with four out of the eighteen sulphides selected for examination, viz., stibnite, galenite, sphalerite, and pyrrhotite. The tests were made as follows: The pulverised minerals were placed in test-tubes, a concentrated solution of citric acid was added, and a piece of paper moistened with plumbic acetate was suspended in each tube, which was then corked. After standing twelve hours at the ordinary temperature, the blackened test-papers gave evidence of the decomposition. Sphalerite seems to be the most readily decomposed, the sulphuretted hydrogen coming off immediately. On heating, the disengagement of sulphuretted hydrogen is very marked; with boiling citric acid, bornite and bournonite, in addition to those just mentioned, yield sulphuretted hydrogen. One sample of argentite, containing mingled galenite, gave a reaction for sulphuretted hydrogen; but a purer specimen was not attacked. With bournonite the reaction is feeble.

Pyrite, marcasite, molybdenite, charcolite, cinnabar, argentite, niccolite, smaltite, chalcopyrite, ullmannite, arsenopyrite, and tetrahedrite, resist the action of citric acid. Tartaric and oxalic acids act in a similar manner, both in the cold and on boiling. A comparison of the behaviour of nine organic acids with stibnite gave the following results:—

(*a*) Stibnite, heated with citric, tartaric, and oxalic acids, yields sulphuretted hydrogen freely and goes into solution.

(*b*) With malic, benzoic, and pyrogallic acids, sulphuretted hydrogen comes off feebly and the mineral dissolves imperfectly.

(*c*) With formic and acetic acids no gas is evolved and the mineral is not dissolved.

(*d*) With picric acid no gas is evolved, but the mineral is partially dissolved.

It is noticeable that the *liquid* acids are powerless to effect decomposition. (Section 8.)

13. The action of the organic acids on mineral sulphides is not so decided as that of the mineral acids; but this is no disadvantage, since it affords additional means of determining them. On examining the reactions recorded in the preceding section, it will be found that bornite and pyrrhotite are decomposed by citric acid, while their kindred compounds, pyrite and chalcopyrite (as well as chalcocite), are not. In order to establish satisfactorily this difference of behaviour, several specimens of each of these minerals, from various localities, were carefully tested.

(*a*) Four samples of bornite were heated with a concentrated solution of citric acid, and each gave a strong reaction for sulphuretted hydrogen; of four specimens of chalcopyrite, treated in the same manner, two gave no traces of this gas, and two gave mere traces on long boiling; three samples of chalcocite yieded no traces of sulphuretted hydrogen.

(*b*) Three specimens of pyrite heated with citric acid gave no traces of the gas, and three of pyrrhotite liberated it both in the cold and freely on boiling. On the other hand, all the specimens named are decomposed by hydrochloric acid, except one specimen of pyrite (from Germany).

It is evident, then, that citric acid may be used to distinguish pyrrhotite from pyrite, and bornite from chalcocite or chalcopyrite. The presence of galenite in argentite may also be ascertained by this method, since the former yields H_2S even in the cold, while the latter is not decomposed on boiling.

---

* Read before the New York Academy of Sciences, April 30, 1877.

† "Cf. Handwörterbuch der Chemie," article "Citronsäure."

‡ *Bull. Soc. Chim.*, xxvii., p. 3, 1877.

‖ Experiments were made to test the applicability of these methods of generating hydrogen to the detection of arsenic by Marsh's apparatus. If a solution containing arsenic be introduced into a flask in which hydrogen is evolved from the action of citric acid on zinc, the disengagement of gas is greatly augmented and arseneted hydrogen forms at once. Owing to the imperfect solubility of zinc citrate, the action soon ceases. With tartaric acid the same objection arises, while oxalic acid is out of the question. This difficulty does not apply to magnesium, which might be employed in an apparatus similar to that described by Dr. John C. Draper (*American Chemist*, ii., 456). By using distilled magnesium and re-crystallised citric acid, the absence of arsenic in the materials used for toxicological researches could be placed beyond suspicion.

OXIDES.

14. A few of the mineral oxides examined are attacked by the organic acids in the cold; brucite dissolves slowly, but to a considerable extent, in cold citric acid; the manganese oxides, hausmannite, pyrolusite, manganite, psilomelane, and wad, decompose the organic acid with evolution of carbonic anhydride; the reaction begins in the cold, and on applying heat proceeds rapidly with a lively effervescence.

$$9MnO_2 + 10H_3C_6H_5O_7 = 9MnHC_6H_5O_7 + 13H_2O + 6CO_2.$$

Manganite is not so soluble as the others, probably because the oxidising power of the sesquioxide is less than that of manganese dioxide. The minerals are apparently more quickly and completely dissolved by oxalic acid than by citric acid.

Zincite, cuprite, and limonite are attacked by boiling citric acid, the latter but slightly. Hematite, magnetite, franklinite, and chromite are not attacked. In testing these minerals, conclusions were based on the reactions of the filtrates; in employing ferrocyanide of potassium to test the citric acid solutions of the iron oxides, we observe that the organic acid exerts a reducing action on the ferrocyanide, and produces a bluish precipitate proceeding from this reagent itself. This is especially noticeable on boiling, a light bluish green precipitate forming abundantly. Tartaric and oxalic acids act similarly.

The oxides behave with tartaric acid in all respects as with citric.

SUNDRY MINERALS.

15. A few minerals not closely related were examined as to their behaviour with citric acid. Gypsum appears to be somewhat more soluble in a concentrated solution of citric acid than in water. Apatite is feebly attacked on boiling. Vivianite is readily soluble. Pyromorphite and anglesite are partly decomposed even in the cold, as shown by the behaviour of the filtrates with hydrosulphuric acid.

Fluorite, cryolite, and samarskite are not attacked, as might be anticipated.

SILICATES.

16. Those silicates which are decomposed by hydrochloric acid, either with or without the formation of a jelly, are likewise attacked more or less strongly by a hot solution of citric acid. The minerals were examined as follows:—Their behaviour with strong hydrochloric acid was first ascertained, and they were then heated with a concentrated solution of citric acid; the solution becomes viscid by concentration, and the gelatinous silica is best seen by diluting with water and agitating. Very careful pulverisation of the mineral is in most cases indispensable. The solubility of the mineral was also tested by filtering from the silica and undissolved material, and examining the solution with an appropriate reagent. Owing to the power possessed by citric acid (in common with other organic bodies) of preventing precipitation of salts which are otherwise insoluble, care was had to select those reagents which were least affected; in this we were aided by a table contained in Dr. Hermann Grothe's paper, entitled, "Ueber das Verhalten der Metalloxydauflösungen gegen Alkalien bei Gegenwart nicht-flüchtiger organischer Substanzen und ueber den Nachweis der Metalloxyde in solchen Lösungen."*

So far as possible, colour reactions were employed.

The results are summarised below:—1, signifying minerals which decompose readily; 2, those which are attacked with difficulty; 3, those which resist the acid. Minerals which yield gelatinous silica are marked G, and those which give slimy or pulverulent silica, S.

* *Journ. für Prakt. Chemie*, vol. xcii., p. 175.

Behaviour of Certain Silicates with HCl *and with Citric Acid.*

Mineral.	HCl.	C.
Wollastonite	1G	1S
Chrysolite	1G	2
Olivine	1G	3
Willemite	1G	1G
Wernerite	1-2	3
Chondrodite	1G	1-2G
Datolite	1G	1G
Pectolite	1G	1G
Chrysocolla	1	1
Calamine	1G	1G
Prehnite	1	2
Apophyllite	1S	2S
Rhodonite	1	1
Natrolite	1G	1G
Analcite	1S	1S
Chabazite	1S	1S
Stilbite	1	2
Serpentine	1S	1S
Retinalite	1S	1S
Chrysotile	1S	2-3
Deweylite	1S	1S
Talc	3	3
Epidote	3	3
Orthoclase	3	3

In order to ascertain approximately the comparative decomposing power of the commoner organic acids with silicates, two which yield readily to citric acid and one which is attacked with difficulty were selected for treatment. The following are the results:—

	Calamine.	Natrolite.	Prehnite.
Citric acid	1G	1G	2
Tartaric acid	1G	1G	3
Oxalic „	2	3	3
Formic „	1G*	1	3
Malic „	1G	1G	3
Acetic „	1G	2-3	3

* Very soluble.

Since calamine and willemite are sometimes distinguished by their behaviour with acetic acid—the former gelatinising and the latter giving slimy silica—it was thought of interest to examine their behaviour with other organic acids. The results are given below:—

	Calamine.	Willemite.
Citric acid	1G	1G
Tartaric acid	1G	1*
Oxalic „	2	2
Formic „	1G	1S
Malic „	1G	1
Acetic „	1G	1S

* Solution becomes very milky in appearance.

(To be continued)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 21, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors, reading of minutes, &c., the following certificates were read for the first time:—T. H. Norton, J. Tchermiac. The following gentlemen were elected Fellows:—L. T. Wright, W. Hudson, T. Lichtenstein, G. S. Johnson, and W. B. Lowe.

It was then announced from the Chair that the following would retire from the Office of Vice-President:—Dr. Gilbert and Dr. Stenhouse; from the Council—Dr.

Attfield, and Messrs. Phillips, Tuson, and Hyde Hills. The names proposed to fill the above vacancies were—as Vice-Presidents, Prof. N. S. Maskelyne, and Dr. Angus Smith; as members of the Council, Dr. Tilden, and Messrs. Riley, Warington, and Carteighe.

The PRESIDENT then called upon Mr. J. Y. BUCHANAN to deliver his lecture, "*Laboratary Experiences on Board the Challenger.*" Mr. Buchanan commenced by describing to the Society his laboratory. It was 10 feet long, 5 feet 8 inches broad, and 6 feet high, and although the dimensions seemed small there was practically quite room enough for one worker. The laboratory was situated in the middle of the ship on the main deck on the starboard, *i.e.*, the right hand side looking forwards. A locker, 2 feet 6 inches high and 2 feet broad, ran across the whole of the front side of the laboratory. Supposing that the visitor takes his seat on this locker, looking aft, the following description will convey a rough idea of the interior. Immediately on his left is a gun-port, which, in the absence of the gun, provides light and ventilation for the room; some light is also obtained from windows in the deck. The locker contains the stores of glass and porcelain, a balance, microscopes, &c. On the right is the blowpipe table; a spirit-lamp, formed of a wide mouth stoppered bottle and having a large wick, was found to yield the most convenient flame; a tallow lamp was abandoned on account of the trouble of melting the tallow. On the left hand side, further aft, is seen the principal working bench, 3 feet 10 inches high, furnished with drawers containing the reagents, each bottle in a separate compartment; on the top of the bench battens are nailed so that the bench presents the appearance of the frame of an ordinary door without the panels; into the places where the panels should be the drawers of reagents can be fitted while in use, and so are prevented from shaking down. Ordinary retort stands were found to be useless, and the following stands were used:—A half-inch metal rod was taken and a long eye cut out at one end, like a needle. Into this eye fitted a staple, driven into the joists forming the roof of the laboratory. By this arrangement the retort rod had a certain play up and down. The retort rings, having been slipped on from the bottom, the rod was lifted, and then pushed down into a hole made for the purpose in the teak bench. This plan was found very convenient, and when not in use the rods were turned up, the eyes forming a pivot, and hooked along the roof. For evaporating, drying, &c., a cast-iron frame, set in gimbals, and fixed to the side of the laboratory, was found quite sufficient, even during the most violent movements of the ship. In the further left hand corner are the sink and the distilled water vessel. Along the further end are wooden shelves with holes for various pieces of glass apparatus; many vessels, &c., were slung from and between the beams supporting the deck. On the right hand side are seen the bottles of standard solutions with burettes; the latter were made like pipettes, and filled by sucking up the solutions from below; in this way barium hydrate solution was found to keep its titre for two to three months, though used every day. On the same side the specific gravity apparatus, hydrometers, and piezometers were stowed away. The lecturer stated that in all ordinary weathers, and in fact as long as the port which lighted and ventilated his laboratory could be kept open, he found no difficulty in working on board ship.

Mr. Buchanan then proceeded to explain the various investigations he had carried out as to the compressibility of distilled and sea-water, mercury, glass, &c. Before starting it seemed to him very desirable to have some means of checking the depths as indicated by the sounding-line, and it was clear that some sort of barometric method must be used. Air had already been tried without success, and so water was finally adopted. The piezometer used consisted of a thermometer, the bulb having a capacity of about 9 c.c., the stem being 13 inches long and 1 m.m. in diameter. The thermometer was inverted, after filling with water, in a little flask filled with mercury; the neck of the flask is connected to the stem by a short piece of india-rubber tubing, between which and the stem a piece of glass rod is inserted so as to admit the external pressure to the surface of the mercury. By warming the bulb enough water is forced out to allow the mercury, on cooling the apparatus, to rise to a convenient height in the stem. In the stem is a little index similar to those used in Six's thermometer. The stem is divided into millimetres, and was carefully calibrated. If such an instrument be sunk with a sounding-line it is clear that the water will be compressed and that the mercury with the index will rise, such rise being the sum of the decrease in temperature plus the increase of pressure. If a thermometer properly protected be sunk at the same time the temperature will be registered, and thus the increase of pressure can be found. Before starting it was thought that a gauge similar to those used with hydraulic pumps might be employed to determine the pressure, but on examination the gauge furnished was found unreliable, and after all the length of the sounding-line furnished the best gauge of the pressure, provided that care was taken that no currents, bad weather, &c., interfered with the result. If there is a current its existence is always rendered evident by the behaviour of the sounding-line as it goes up and down; so that practically there is no difficulty in saying when a sounding is good. The Lecturer experienced some difficulty with the springs of the indices, and it was only on his way home between Tahiti and Valparaiso, in a depth of 2000 to 2500 fathoms, that he was able to get satisfactory results as to the compressibility of water. As a mean the compressibility of distilled water per 100 fathoms was found to be 0·0009, or, per atmosphere, 0·000049; Regnault finding 0·0000486. The results at various depths agreed well; thus, at 1000 fs., 0·00008; at 2000 fs., 0·0009; at 3000 fs., 0·0008. The compressibility of sea-water was determined in precisely the same instrument, and was found to be, at 800 fs., 0·00077; at 1000 fs., 0·00078; at 1500 fs., 0·00073 per 100 fathoms. These experiments were all made by attaching the piezometer to the sounding-line, the temperature being from 1° to 3° C. In order to determine the compressibility at higher temperatures recourse was had to a hydraulic instrument; but as no reliable gauge was at hand the only results possible were comparative, between sea-water and distilled water. At 26·5° C. (distilled water = 100), 93·6; 25·8°, 92·0; 22·1°, 92·8; 22·5°, 92·0; 13·7°, 92·6. A solution containing 4 per cent sodium chloride gave results:—(Distilled water = 100) 26·5°, 90·51; 25·8°, 88·13; 22·1°, 86·61; 13·7°, 86·84. The compressibility of mercury was next determined and found to be, per 100 fathoms, 0·0000271; per atmosphere, 0·0000015.

The apparent compressibilities of water and mercury having been thus determined, the next task was the practical one of applying the results to control the soundings as obtained by the line, and the temperatures as indicated by the thermometer. Two piezometers, one charged with water the other with mercury, were sent down on the sounding-line. Now water is very sensitive to changes of pressure, but not to changes of temperature. Mercury, on the other hand, is less affected by changes of pressure, but considerably more by variations in temperature. The true temperature and true depth were obtained from the readings of the two instruments thus:—The rough depth, as given by the sounding-line, is applied to correct the temperature as indicated by the mercury piezometer. By this temperature the reading of the water instrument is corrected, and thus the correct depth is obtained to within 25 fathoms. This is again applied to the mercurial instrument, and so, by correcting backwards and forwards, both the correct depth and the correct temperature are found. For great depths the piezometer above described is useless, a pressure above 3000 fathoms forcing the mercury into the bulb. To obviate this difficulty a bulb was blown in the middle of the stem, and its size was so arranged that the contraction up to 1500 fathoms was covered by this

bulb, and so the stem was left to indicate greater pressures. The lecturer had endeavoured to measure the compressibility of glass, but for want of accurate measuring apparatus good results had not yet been obtained. The apparatus consists of a glass tube, in which is a glass rod slightly shorter than the tube: an index is brought down on to the rod. When exposed to pressure the glass tube contracts; the rod, however, maintains its length, and as a consequence the index is pushed up, and thus the amount of contraction is determined.

The Lecturer then described the apparatus by means of which the amounts of oxygen and nitrogen in sea-water were estimated. About 900 to 1000 c.c. were used. The sample was collected in a brass cylinder furnished with stop-cocks having a ⅜-inch bore, and was transferred to the flask in which it was to be boiled with as little disturbance as possible. To the flask is fitted an india-rubber cork, through which a glass tube, having a large bulb attached to it, passes. The tube and bulb are filled with distilled water, the end of the tube in the flask being closed by a simple device. The bulb is now boiled for ten minutes, and the upper end of the tube closed. The lower end is now connected with the water in the flask, and the latter boiled for one and a half to two hours. The gases evolved are collected in the bulb and analysed. The carbonic acid was determined by distilling about ½ litre of water to dryness after the addition of 15 c.c. of barium chloride solution to prevent bumping. The steam was passed through a still, and the distillate with evolved gases collected in flasks and U-tubes containing standard baryta-water. This, by titration with hydrochloric acid, rosolic acid being used as an indicator, gave the amount of carbonic acid. The following are the results of the analyses of about one-third of the gas samples obtained:—Oxygen + nitrogen = 100. In surface-water O = 33·67; at 25 fathoms, 33·4; 50 fs., 32·3; 100 fs., 30·2; 200 fs., 23·4; 300 fs., 11·4; 400 fs., 15·5; 800 fs., 22·6; below 800 fs., 23·5. So that, from the surface downwards, the oxygen decreases to 300 fathoms, below this depth it increases in amount. This increase is in all probability due to the decreasing amount of animal life at depths greater than 300 fathoms. Experiments with the tow-net at various depths confirmed this view. As regards superficial distribution, the cold water at the Antarctic regions, both at the surface and below, is thoroughly aërated, the gases diminishing in quantity as we approach the Equator, increasing again as we proceed northwards. From many experiments it was found that the absorption of nitrogen by sea-water varies considerably from that by distilled water, especially at high temperatures. The lecturer then pointed out the distribution of sea-water as regards density in depth and superficially with the aid of several diagrams. Two regions of maximum density exist, north and south of the Equator. The north maximum being 25° N. of the Equator, the south about 15° S., towards the Equator the density at the surface falls off, whilst towards the Arctic and Antarctic regions the density decreases rapidly. These regions of maxima correspond to the regions frequented by the trade winds. It is known that the South trade blows much nearer the Equator than the North, and so the maximum of density is nearer the Equator on the South. As to vertical distribution the maximum penetrates some depth, but at 350 fathoms a great tract of water of low density is found. At the Equator we find, first, an increase as we go down, then a decrease, and last of all again an increase of density near the bottom. The densest water is found in the Atlantic. In the Pacific a certain imitation of the areas of dense water just described is found. Near ice very light water is found; again, near Hong Kong, just after the monsoons, the superficial water is very light, but during the dry season the water becomes more dense. The maxima of density lie in the North Hemisphere to the S.W., in the South to the N.W., of the maxima of barometric pressure. It is at these latter spots that the cold dry winds descend from great altitudes, and flow outwards, taking up moisture from the sea in their course, and not becoming saturated until they are near the Equator.

The PRESIDENT said that the very best thanks of the Society were due to Mr. Buchanan for the very careful lecture just delivered. He had invited them first into his small but compact laboratory, and explained the ingenious methods for determining various physical questions. He had then detailed the more distinctly chemical results, of great interest, as to the distribution of gases, and especially as to the diminution of oxygen, above and below 300 fathoms, with respect to which he would like to ask whether this always held good for 300 fathoms whatever the total depth might be?

Mr. W. L. CARPENTER had listened with great interest to the lecture, especially as he had performed the same sort of work on board H.M.S. *Porcupine*. His laboratory was much smaller, the naturalist and himself having a table only 4 feet square between them. He was glad to hear that Mr. Buchanan's extended experience confirmed in several respects the results which he had arrived at. He would like to ask why the carbonic acid had been separately determined? whether an increase in the quantity of oxygen had been observed during rough weather in the surface water? whether any effervescence had been seen in water brought up from great depths? and whether any chlorine estimations had been made in relation with the specific gravity determinations.

Mr. WARINGTON asked if any determinations of ammonia and nitric acid had been carried out, with reference to the theory that the trade winds came to our shores rich in ammonia, while our soils lost nitric acid to the rivers, &c.?

Mr. BUCHANAN replied that the depth of 300 fathoms was irrespective of the total depth; that the carbonic acid was determined separately because it had been shown that it could not be satisfactorily driven out of sea-water by boiling *in vacuo*. In one case of cold water, brought up near the River La Plata, he had seen effervescence resembling that of natural Seltzer water; but from want of time he had not made any number of chlorine, nitric acid, or ammonia determinations.

A hearty and unanimous vote of thanks was then given to Mr. Buchanan for his interesting lecture, and the Society adjourned to March 7th.

EDINBURGH UNIVERSITY CHEMICAL SOCIETY

Fifth Meeting, February 20, 1878.

JOHN GIBSON, Ph.D., F.R.S.E., in the Chair.

MR. W. L. GOODWIN read a paper "*On a Method of Removal of Iron from Cupric Sulphate for Analytical Purposes*," in which he stated that this could be done by the replacement of the iron by cupric hydrate.

Mr. ALEXANDER MACFARLANE, M.A., B.Sc., read a paper "*On the Disruptive Discharge of Electricity*," in which he gave the difference of potential necessary to produce sparks at different distances, and also with different pressures, and gases as dielectrics.

PHILOSOPHICAL SOCIETY OF GLASGOW.

CHEMICAL SECTION.

January 14, 1878.

Professor JOHN FERGUSON, M.A., President, in the Chair.

AFTER the confirmation of the minutes, a paper was read "*On Bishop's Improved Process of Regenerating the Lime used in the Purification of Coal-gas*, by Mr. JOHN MAYER, F.C.S., Secretary of the Section. The author said that he had for many years taken a great deal of interest in the chemistry of gas purification, and the secondary or

waste products of the gas manufacture, and that during the last few months the process about to be spoken of had impressed itself on his mind as one which was a great step in advance, inasmuch as its use bade fair to be attended with a large amount of economy, and to diminish very considerably the nuisance which seemed invariably to result when "fouled" gas-lime was permitted to remain about a gas-works, and more especially when it was being removed as a so-called "waste-product." Almost from the very birth of the gas-making industry the basic alkaline earth, lime, had been used in the purification of gas. For a considerable period, down even to within the recollection of some of those then present, the purifying material was used in the form of a thick milk of lime, in cast-iron tanks; but though the operation was very successful, from a chemical point of view, it was attended with mechanical difficulties that were of so serious a character—in addition to the difficulty of so disposing of the very fœtid waste lime liquor as not to create a nuisance—that it was eventually superseded by the use of dry lime purifiers, the slaked lime being laid on trays or grids in covered chambers or tanks, and allowed to remain exposed to the contact of the gas in its passage from the retorts, where it was generated, to the gasholder, where it was stored. Until within the last eighteen or twenty years, caustic or hydrated lime reigned almost supreme as the purifying agent; but when it was experimentally demonstrated that hydrated peroxide of iron might be used with great effect in removing the impurities from coal-gas, it began to establish its claims and its popularity over lime in many of the large gas-works throughout the kingdom, and especially in those of the Metropolis. One of its chief advantages was that it did not, by exposure in the open air, become a nuisance in the same degree as spent lime did; and another was, that it could be used over and over again. But it was found that, by itself, it was not sufficient for the removal of all the impurities, and some gas managers got into the practice of using it in admixture with slaked lime and sawdust, while others considered it preferable to use the lime and oxide of iron in separate purifiers, which was the plan now generally had recourse to where the last-named compound was employed as a purifying agent. In small gas-works, however, it might be said that lime was almost exclusively used in the purification of the gas, which was also the case in many works of pretty considerable size. Such a process, therefore, as that to be briefly noticed in the paper might well aim at becoming very general, if it could only be satisfactorily shown that it was a success—chemically, mechanically, and commercially.

Before enlarging upon the process, the author noticed briefly what were the impurities which it was desired to remove from the gas. He next spoke of the nature of spent or fouled lime. He then quoted several analyses of spent lime at some length, and said that the product in question was of a very variable composition, owing partly to its freshness, partly to the length of time during which it had been exposed to the action of the gas in the purifiers, and to other causes. There was no doubt, he remarked, that by allowing the spent lime to weather in the open air it would, in course of time, consist largely of sulphate of lime, in consequence of the slow oxidation of the sulphide and other easily transformed calcium compounds. After referring to certain very suggestive remarks of Mr. Lewis T. Wright, on the chemical action which takes place in a dry lime purifier, the author proceeded to say that, as to the very complex composition of "fouled" gas-lime there could be no doubt whatever; but how to turn the substance to account profitably, and reduce the nuisance connected with it to a minimum, was a question that had occupied the attention of many gas-managers and chemists. Certainly the most successful worker in that field of practical investigation up to the present time, so far as he was aware, was Mr. George R. Hislop, F.C.S., the well known manager of the Paisley Corporation Gas Works. That gentleman had attacked the problem of regenerating or revivifying spent gas-lime some years ago. He took some large blocks, and calcined them with coke in the usual way, and the results were upon the whole very successful. The great difficulty, however, was how to re-calcine the smaller portions of the lime, and, in order to get over that difficulty, he had a quantity of gas-lime passed through a pan-mill, in which the lime was broken down, in order to give it a suitable consistency, and fitted for being easily moulded into bricks, which were introduced into a kiln in the usual way. So far the process satisfied him. The bricks were well formed, and in a way that they could be handled and placed in the kiln. But he was not entirely satisfied with the process, as it was impossible, under ordinary circumstances, to make sure that the lime in the centre of the bricks was completely re-calcined or revivified, and he eventually came to the conclusion that the spent lime must be recalcined in as fine a state of division as possible. His experiments gradually led him to devise a furnace or kiln of special construction for the purpose, and with it he had now been working on a practical scale for many months. Indeed, he had informed the author that the lime which he was using in the purification process at his works was that which he obtained by calcining raw limestone in the ordinary way about a year ago, and that he had now entirely discarded raw limestone, whereas he formerly used 800 to 1000 tons of that material per annum.

The author said that he had seen the lime-generating process in operation several times at the Paisley Gas Works; he had also seen it in operation at the Greenock Corporation Gas Works; and in the hands both of Mr. Hislop and Mr. Samuel Stewart it seemed to work exceedingly well, and to be, indeed, a very marked success. Proceeding to describe the process, he said the kiln consists of a series of four calcining chambers arranged vertically over each other, and, together with the furnace underneath them, occupying the space of one of the ovens of the retort-bench. They are about 9 feet long and 2 feet 6 inches wide. The uppermost, which is the drying-chamber, has a capacity fully equal to the united capacity of the other three, which are the calcining-chambers proper, and are each about 9½ inches high. All the chambers are constructed of fire-clay tiles and blocks of similar form. The gases from the furnace pass to the further end of the same, where, by means of two ports at the corners, they pass into the lowermost calcining chamber over the top of, and in close contact with, the spent lime to the fore end of the same; thence up through two ports as before, traversing the second chamber in the same way; then the third chamber; and, lastly, the topmost or drying chamber, from which they enter the main flue, the entrance to which is regulated by a suitable damper. The spent lime is first charged into the drying-chamber by means of a shovel, and it remains in that chamber during the regeneration of the contents of the chambers underneath; and after the latter have been discharged into an iron waggon or barrow, the contents of the upper chamber are discharged into the lower chambers through a port near to the front of each, the opening of which is covered with a suitable tile, as the chambers are successively filled, commencing at the lowermost, and the gases from the furnace, while passing over, and in close contact with, the spent lime, disengage the carbonic acid and other impurities. Air is admitted through ventilating flue-boxes, placed on either side of the furnace near to the ground, whence it is conveyed to, and directed against, the fuel in the furnace near to the centre of the furnace-bars, where it issues from a number of holes, about 1½ inches in diameter, pierced through fire-clay blocks, which form part of the sides of the furnace. These air holes pass through the blocks with a dip of about 1½ inches towards the furnace-bars. In practice it is found that one man can attend to two sets of chambers such as those just described, and regenerate upwards of 50 cwts. of spent lime per shift of twelve hours, with a consumption of about 8 cwts. of fuel, which is usually the coke of ordinary cannel coal.

Mr. Mayer remarked that, so far as the drying and re-calcining of the spent lime were concerned, the operations which he had seen at Paisley and Greenock were practically the same; but he had learned from Mr. Hislop that he was making arrangements for carrying out another part of his process, and which, indeed, he had seen in progress. When oxide of iron, he said, was employed along with lime in the purification of the gas, the last-named compound was produced chiefly in the state of carbonate, and was therefore ready for recalcination immediately that the purifier containing it was thrown out of use; and, according to Mr. Hislop, it might be fouled and revivified for an indefinite number of times, say a hundred, more or less. But when no oxide of iron was employed, the lime produced was largely charged with sulphur, as well as carbonic acid and other impurities; and while that lime might be restored from fifteen to twenty times, or more, before becoming exhausted by its combination with sulphur, forming sulphate of lime, that gentleman had provided in his process that—in order to render the lime more durable and "go on for ever"—the waste gases from the retort furnaces, boiler furnaces, or the calcining chambers themselves, consisting chiefly of carbonic acid, should be drawn off by an exhauster or pump, and forced up through the spent lime, after being shut off from the gas as fouled in the purifier. His intention was to connect the chimney, or main flue, with the purifiers, by means of cast-iron pipes laid in a cold-water condenser. By that arrangement the carbonic acid from the sources referred to would, on being passed through the sulphuretted lime in the purifier, displace the sulphur chiefly in the form of sulphuretted hydrogen, and combine with the lime to form lime carbonate. The discharged gases from the fouled purifier would then be passed through oxide of iron in an adjoining purifier, the residual gaseous matter being allowed to pass into the open air or into a chimney, and the oxide of iron, after absorbing all the sulphurous impurities, as in gas purification, being removed and exposed to the air for revivification in the usual manner, and the carbonated lime transferred to the calcining chambers, and restored to the condition of quicklime as before.

In concluding, the author regretted that, owing to the short time at his disposal for preparing the paper, there had been no opportunity for getting analyses made of gas lime which had been a number of times fouled and re-calcined, so as to see if there was any material and gradual increase in the amount of sulphate of lime. On that point, however, he had been informed that there seemed to be no diminution in the purifying power of re-calcined gas lime. In other respects the paper had been incomplete; but he was glad to see Mr. Hislop and Mr. Stewart present, both of whom would doubtless be willing to supplement his remarks from their own practical experience of the process.

A discussion then took place.

Mr. J. J. COLEMAN, F.C.S., said that it would be essential to the financial success of the process that all sulphur compounds should be removed from the gas prior to the latter being brought into contact with the lime, otherwise there would, he thought, be a progressive deterioration of the lime each time it was re-calcined. He considered that this would practically be very difficult to manage. If the lime were deteriorated only to the extent of 10 per cent at each re-burning, by accumulation of sulphates or sulphides,—a not unreasonable possibility,—then by the end of the fifth re-calcination the cost of re-burning would exceed that of fresh lime. The removal of sulphur from coal-gas by ferric oxide, and its recovery from the oxide by conversion into sulphurous acid in the vitriol chamber furnace, or its recovery in the free state by the process of Pelouze (now in operation in London),—namely, by solution in hot coal-tar naphtha and subsequent crystallisation,—were operations of great interest, and likely to have an important influence in rendering us independent of foreign sources of supply.

Mr. SAMUEL STEWART (Greenock) remarked that he had been using the process, and burning the spent lime, for about two months, during which time he had re-burnt about 100 tons of the lime, or, in other words, about double that quantity of spent lime, for the latter lost nearly half its weight in the process of revivifying. He had found no difficulty or mystery in re-calcining the spent lime. The re-calcining chambers at the Greenock Gas-Works occupied the place of an ordinary oven of retorts in the retort-bench, and they were worked at six-hour charges, producing something like 45 cwts. of re-burnt lime per twenty-four hours. The lime was found to stand in the purifiers equally well with, and also about the same time as, the "shell" lime, even after being re-calcined several times. He said, however, that he only used lime to remove the carbonic acid from the gas, the sulphuretted hydrogen being removed by means of bog iron-ore. The spent lime, therefore, contained very little sulphur. Speaking of the "life" of the chamber, he said that he estimated that it would be equal to the production of from 800 to 1000 tons of re-burnt lime; and he calculated the expense of renewing the chamber at from £40 to £50, or about 1s. per ton of re-burnt lime. He found that the cost of labour and fuel did not exceed 9s. per ton, or, adding 1s. for renewal, say 10s. per ton, or about one-half the cost of new "shell" lime. Not having had an opportunity of getting either the spent or re-burnt lime analysed, he was unable to say if all the impurities were driven off by the re-burning.

Dr. WALLACE, Gas Examiner (Glasgow), remarked that if any sulphur compounds remained in the spent lime, the burnt lime would contain sulphate, He had found that when limestone containing pyrites was calcined, the product retained fully half of the sulphur in the form of sulphate. The value of the process would, therefore, depend very much upon the extent to which the sulphur compounds were got rid of before calcination. Again, the utility of the invention would depend upon local circumstances. In London, for example, the process would be invaluable; and in places where the spent lime could not be disposed of advantageously it would undoubtedly be profitable. But in such towns as Glasgow, where the waste lime was readily sold, it became simply a question of cost whether it would be better to revivify the spent lime or use fresh material every time. The price got for spent lime in Glasgow was from 1s. 6d. to 2s. 6d. per ton, which was equal to from 3s. to 5s. of the cost of the original lime, and that amount added to 9s. as the probable cost of revivifying, came pretty close upon the value of burnt Irish lime—that was to say, about 16s., all charges included.

Mr. G. R. HISLOP (Paisley) said that, not being a member of the Society, he had attended, on the invitation of Mr. Mayer, simply as a listener to what might be said on the subject discussed in the paper. He expected that had Mr. Mayer's paper come on a week or two later, he would have been in a better position to state important facts in connection with the subject, and to have been able to submit analyses of the lime at the different stages of the process, and after several re-burnings; but he was only then engaged in perfecting the desulphuretting part of the process. Undoubtedly it was of great importance to have the last vestige of the sulphur discharged from the fouled lime before re-calcining it, and this he proposed to do by means of the carbonic acid produced in the gas-retort furnaces, sufficiently cooled and passed up through the lime in the purifiers, so soon as they were turned off as fouled. In that way the carbonic acid gas, passing through the myriads of channels formed in the lime, would very speedily discharge the sulphuretted hydrogen, which in its turn would be passed into the oxide of iron. The simple acetate of lead test would indicate when the whole of the sulphuretted hydrogen had been expelled. By that part of the process the valuable sulphur, which had been largely, and in most cases, thrown away as waste, would be recovered. It was by no means a small quantity of

sulphur that was allowed to go to waste; for, after allowing for what might be removed by the scrubbers and washers, it would amount to from 10 lbs. to 13 lbs. per ton of coal carbonised. That was a point not to be lost sight of. Mr. Stewart, who, like himself, purified his gas partly by oxide of iron, intended, in the meantime, to burn his lime with what little sulphur it might contain, and, with regard to the number of times it might be recalcined, he (Mr. Hislop) might state that, of the 60 or 70 tons of lime which he had had in use at the Paisley Gas-Works for the past twelve months, a portion which had been fouled forty-five times (and in several instances made specially foul for the purpose of experiment) contained only 22½ per cent of sulphate of lime. Then as to the value of the spent lime, as ordinarily produced,—like Mr. Stewart, he had always had considerable difficulty in getting it disposed of. Not unfrequently, at least in midwinter, he had sold it at from 4d. to 10d. per ton. But, even supposing that 1s. 6d. per ton could be got for the spent lime, as Dr. Wallace had stated, and that it required nearly 2 tons of spent lime to produce 1 ton of quicklime, Mr. Hislop found that well nigh—if not even fully—this sum would be saved in the preparation alone of the reburned lime, which required no riddling or screening, inasmuch as it contained no stones, and altogether it was much more speedily prepared for use. Speaking of the cost of producing quicklime direct from the raw stone, he said that, before resorting to the regular use of his vivifying process, he had produced all the lime required at the Paisley Gas-Works from Irish limestone, and he quite agreed with Dr. Wallace on the question of first cost. The material could not be produced for less than the amount mentioned—namely 16s. per ton.

The President then summed up the discussion in a few remarks, and, in proposing the thanks of the Section to Mr. Mayer for his interesting paper, he expressed a hope that another paper on the subject would be brought forward at a future meeting, in which the desired analytical results would be embodied.

CORRESPONDENCE.

THE INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—So many of my friends in the Institute of Chemistry are under the impression that the "Chemists and Druggists" have done their utmost to oppose the formation of the Institute, that it seems to be almost the duty of one so closely connected with both bodies as I am, without speaking either officially or officiously, to deny that any such antagonism existed or exists, and to assert that pharmacists as a body are entirely in sympathy with the objects of the Institute. Only a fortnight ago a prominent member of the Council of the Pharmaceutical Society wrote as follows in the *Pharmaceutical Journal*:—"To suppose that we could object to a society formed by such distinguished men, and for such high purposes, seems so unreasonable that I need scarcely say a word on that point." No doubt there was, apparently, some temporary opposition to the Institute by the Pharmaceutical Council, but it was exerted not so much in pharmaceutical as in imperial interests, and even that action, for it really was not opposition, was elicited by the initiatory action of the Privy Council, moved by the Board of Trade, in sending on to Bloomsbury the "Articles" for perusal. Some of the objections which seemed to me, when I heard them read by the President of the Institute, to betray legal rather than pharmaceutical leanings vanished on closer investigation. Then the objection to the name "Institute of Professional Chemists" the President of the Institute himself admitted to be fair; for, said he at the recent Annual Meeting, "pharmaceutical chemists might with great propriety, term themselves professional chemists; hence, perhaps it was unwise to take that title without limitation." We must remember that at that early stage of organisation of the Institute pharmacists had no guarantee that persons should not acquire the designation "Professional Chemist" by means inferior to those by which the title "Pharmaceutical Chemist" is acquired, and then forsaking the chemistry they never intended exclusively to follow, foist themselves on the public as qualified pharmacists in defiance of the Pharmacy Act, and under a name not likely to be distinguished by the mass of the public from that of "Pharmaceutical Chemist." We now know that the Institute would not be likely to admit such men. I may parenthetically observe, however, that I cannot see how men of that sort would have been kept out had the Institute been started by public announcements, as some desired, instead of by the present quiet and wonderfully successful mode; a method which, notwithstanding the honoured names it has secured, one gentleman has so far forgotten himself as to term "hole and corner." I agree with the Pharmaceutical Councillor already cited in thinking that the Institute ought to thank the Pharmaceutical Society for having saved it from so loose a title. Imagine this shopkeeping "Professional Chemist" exhibiting, in a gilt frame in his window, a grand diploma, which the real professional chemist would never have occasion to use, and the deception will be seen to be complete; while the objection by the pharmacist on his own behalf and on behalf of the public to the granting of such certificates by the Institute will be seen, I think, to be reasonable. At all events the Organising Committee of the Institute seemed to think so, for they altered the name and at once gave up the idea of issuing a diploma; thus quite meeting the not very formidable objections of the pharmaceutical body. Beyond these objections there has really been no opposition whatever, and the net results of even these may be viewed as the mere clearing away of obstacles to the firm foundation of the Institute.

As regards the first part of the title, "Chemist and Druggist," for it has been a real title since 1868, there does at the present time seem to be a little anomaly in giving the name "Chemist" to the men who study chemistry in an inferior degree and legally (though, by the way, not practically) withholding it from the men who study chemistry in a superior degree. That is not the fault of the pharmacist however. Previous to 1868 any petty huckster could, and often did, term himself or practise as a "Chemist and Druggist," or "Chemist," or "Druggist." The authors of the Pharmacy Act, 1868, simply obtained protection for those designations already long in common use. At all events, not a single follower of chemistry seems to have considered himself sufficiently aggrieved to protest against any such restriction of the name "Chemist;" and that being so, is it astonishing that followers of pharmacy should not have been prophetic enough to see that objections to the name might some day arise? Besides, as regards this name "Chemist," the superiority of claim to it now possessed by those who practise chemistry only, has grown up long since the time when the druggist was the only chemist and the only man then having any good claim to be specially termed chemist. For when, in the seventeenth century, artificial mineral, or inorganic, substances came to be used as medicines, their preparation, quite beyond the power of the collector or herbalist, or the seller of drugs—the grocer and druggrocer, hencē, afterwards, drug-gist—was undertaken, or rather grew to be, the province of men who (with some physicians) were the connecting links of the alchemy of the fifteenth century with the chemistry of the nineteenth century. Giving up, as a class, the search forthe elixir of life and the philosopher's stone, they became as a class the chemists and the only chemists. The "Grocer and Druggist" gradually dissociated, the druggist and the chemist working for a common end gradually associated, and hence arose the "Chemist and Druggist." The "Chemist and Druggist"

of to-day, therefore, has something even more tangible than priority of claim to the name of "Chemist." He might indeed, though he does not, complain that although as much a chemist as ever his name should be sought to be taken from him by men already bearing the far richer designations of chemical philosopher and chemical analyst, and this at a time when he has arranged that everyone of his class should know something of this same chemical philosophy and chemical analysis. Of the two classes of so-called chemists who now gain their living as chemists, the "Chemist and Druggist" is just able to say that he reckons his age by hundreds of years, while his namesake, better chemist though he be, only reckons his by tens—for though some of the substances we term chemicals have been known for centuries, chemistry as a science is not a hundred years old. We may regret that followers of chemistry are not exclusively called chemists, and followers of pharmacy pharmacists. But we must take things as they are. It is useless kicking against the pricks. Besides, confusions of this kind generally clear themselves away in course of time.

No. Opposition to the Institute of Chemistry will not, I think, be found in pharmacy, nor, apparently, outside the ranks of chemistry at all; and inside there seems to be none worth mentioning. What may be the number of educational, analytical, manufacturing, or other chemists in Great Britain and Ireland qualified to enter such an Institute no one knows. And what number of men there are, qualified as chemists, and indeed already invited to join the Institute, but who may not be following chemistry as a remunerative profession, and who for that reason may not accept election, no one quite knows. But that within six months of the incorporation of the Institute some 300 men, including all the best practising chemists, should enter its ranks, contributing some £1600 to its exchequer, appears to me to show success most marvellous. Of course, among chemists a Paraffin or two are to be expected, although I trust that sooner or later that name will become entirely, as it already is partially, a misnomer. But while such a body, as the Institute seeks to become, can doubtless progress more harmoniously without than with such men, perfect success depends on the entire, or practically entire, co-operation of the chemists of the whole country. Only by such thorough union can we thoroughly promote the interests of the public, the interests of our calling, and, as a consequence, the interests of ourselves. Such results seem really to be in a fair way of being accomplished, and the utmost credit is due to our President and the Organising Committee. I cannot conceive that any drawing together of the chemists of the country in public meetings, or any other mode of initiating action, could have had such very satisfactory results. Here, at all events, is one successful combination of chemists for the common weal. It is too much to expect that a better or more hopeful combination can ever be brought about. I trust that every chemist in the country who has not already joined will send in his adhesion, and that we shall all maintain the Institute with the utmost dignity and ability we possess: maintain it as an Institution created and continued for the welfare of science and the well-being of the kingdom at large.—I am, &c.,

JOHN ATTFIELD.

Ashlands, Watford.

AMMONIA IN FILTERED WATER.

To the Editor of the Chemical News.

SIR,—Your correspondent M. Gustav Bischoff (CHEM. NEWS, vol. xxxvii., p. 79) seems to utterly ignore the very plainly written statements contained in my letter to your paper of January 4th. I stated that the original water was *almost free from nitrates and albumenoid ammonia*, and could only account for the presence of so great a quantity as 7·3 parts per million in the same water, after filtration through a spongy iron filter, by the well-known fact that metallic iron will contribute to the formation of ammonia by oxidation.

Of course I took every precaution to ascertain from my client the full particulars respecting the situation of the filter, and made many suggestions as to the source of contamination.

The spongy iron filter was placed in a large hall, and far away from a water-closet, gas-burners, or drain.

If ammonia can be formed *at all* by the action of iron upon water and air, surely it is open to credence that 7·30 grains could be formed in one million grains of water. The filter referred to had been in use six weeks.

Of course one could scarcely understand how ammonia could possibly be *formed* in ferruginous earth.—I am, &c.,

GEORGE JONES.

106, Leadenhall Street,
February 25, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 3, January 21, 1878.

This issue contains merely the discourses pronounced by members of the Academy at the funerals of M. Becquerel and M. Regnault.

No. 4, January 28, 1878.

This number gives an account of the various prizes awarded by the Academy.

Justus Liebig's Annalen der Chemie,
Band 190, Heft 3.

Communications from the University Laboratory of Wurzburg.—These communications consist of a paper on the "Splitting-up of Acetic-Ester and its Alkyl Substitution-Products by Bases," by J. Wislicenus; a dissertation, by F. W. Homann, on "Quercite, a Pentacid Alcohol;" a paper, by Leonhard Limpach, on the "Oxidation-Products of Stearolic Acid;" an essay on "Methyl-isomyl Carbinol and Isobutyl Acet-Ester," by W. Rohn; and one by G. Michle, on the "Synthesis of Tricarballylic Acid by Natracetic-Ester."

On Various Amylens and Amylic Alcohols.—A. Wischnegradsky.—The author draws the following conclusions concerning the nature of the amylic alcohol of fermentation and its derivative amylens:—The ordinary amylic alcohol of fermentation, which has generally been regarded as isobutyl carbinol, is probably a mixture of three primary amylic alcohols,—isobutyl carbinol, methyl-ethyl-carbin carbinol (to which the optical action is due), and normal amylic alcohol. Commercial amylen, as prepared by the action of zinc chloride, is probably a mixture of three isomeric C_5H_{10},—trimethyl ethylen, unsymmetri-methyl-ethyl ethylen, and normal propyl ethylen. Ordinary amylen has been taken for isopropyl ethylen, a variety scarcely, if at all, present therein.

Action of Ammonia upon Isatin.—Dr. Erwin v Sommaruga.—For the preparation of isatin in quantity, in which the author encountered at first no little difficulty he recommends the following process:—50 grms. of indigo, reduced when dry to a very fine powder, are stirred up with cold water to a very thin paste, heated to a boil in capacious flasks or capsules, and a concentrated solution of 30 grms. of chromic acid is added in small quantities at a time. As much frothing takes place at the

beginning of the oxidation, the chromic acid must be added with caution, to prevent loss; but as soon as from one-half to two-thirds of the chromic acid have been consumed the remainder may be added more rapidly. When all the chromic acid has been added, the liquid is kept at a boil until the froth, which was at first fine, sinks together, and in its place large bubbles appear on the surface of the liquid. The entire process of oxidation may be completed in ten minutes. The boiling liquid is poured upon a fine linen filter, and gives a filtrate of a fine brownish red colour. On cooling, isatin is abundantly deposited in crystals, contaminated merely with a little brown resin. The chromic hydrate remaining on the filter retains so much isatin that it must be twice or thrice extracted with boiling water. The impure isatin was purified by solution in cold dilute potassa, fractionated precipitation with muriatic acid, and final crystallisation from alcohol. The yield did not exceed 16 to 18 per cent of the indigo employed. The author has examined the action of ammonia upon isatin at strong pressure, when different results appear from those obtained by Laurent in open vessels. Three substances are produced, two of which are genetically connected, whilst the third owes its origin to a separate reaction. No by-products appeared, with the exception of a trace of a beautiful colour, which the author has hitherto not succeeded in isolating.

Moniteur Scientifique Quesneville.
February, 1878.

The papers, chiefly on colouring matters, placed uuder the head "Foreign Researches," are taken from the *Berichte der Deut. Chem. Gesell*,, and noticed elsewhere.

Memoir on Ultramarines.—Emile Guimet.—Already noticed.

Metallurgy of Nickel.—M. Badoureau.—The author mentions the chief nickel mines and works in Europe. The treatment of the sulphuretted and arsenical ores comprises three processes:—Concentration of the ore by a series of roastings and fusions, and formation of a matte or speiss; transformation of this matte or speiss into oxide of nickel and oxide of cobalt, either in the dry or the wet way; and, lastly, the reduction of the nickel oxide, and silicatisation of the oxide of cobalt. The treatment of the silicated ores of New Caledonia is treated of in a separate chapter.

Analysis of Wines.—From this paper, which does not bear the name of any author, it appears that the quantity of the substances present in a litre of wine may vary as follows:—

Solids	13·0 grms.	to	24·0 grms.	
Sugar	0·6	,,	1·1	,,
Acetic acid	0·3	,,	0·6	,,
Tartaric acid	3·8	,,	4·6	,,
Ash	1·3	,,	2·7	,,
Alcohol in 100 grms...	67·0	,,	88·0	,,

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 49, January, 1878.

This issue contains no chemical matter except what has been obtained from English sources.

Reimann's Färber Zeitung,
No. 5, 1878.

This issue contains nothing of general interest.

No. 6, 1878.

In a paper read by Dr. F. Fol at a meeting of the Dyers' Association at Berlin it was maintained that the quercitron used in dyeing is not bark but wood. Neither the president nor any of the dyers, &c., present had ever heard this view put forward, and further light upon the subject was demanded.

Bulletin de la Societe Chimique de Paris,
No. 2, January 20, 1877.

Reply to M. E. Guimet.—J. F. Plicque.—The author maintains that from a merely scientific point of view, the idea of substituting selenium and tellurium for sulphur is his own.

NOTES AND QUERIES.

Analysis of Oil-Cake.—I shall feel obliged if anyone can inform me where I can find any account of the analysis of oil-cake.—A. P. S.

Arsenic in Pyrites.—I shall feel obliged if any of your correspondents can inform me which is the best way to estimate correctly the small quantity of arsenic contained in pyrites, or refer me to some book or memoir where a good practical method is described?—Constant Reader.

Prevention of Hydrophobia.—Immediately a person is bitten open the wound with a lancet or other sharp instrument; wash with hot water, then well brush and bathe the place with a very strong solution of bichromate of potash: do not cover the wound, but let it be exposed to the air as much as possible. In a few days the place will commence to ulcerate into (in all probability) a round sore, which will cake over with a scab: this will in time come out, and the place will close with new flesh. Keep the bowels well regulated. I have found this treatment most effectual for the bites of dogs, and for staying the course of ulcers, &c., on the human body.—J. H. Swindells.

Colouration of Water.—I am connected with the Stourbridge Canal Co., on the banks of which are what are called Tin Works, *i.e.*, first iron is rolled in the sheet, and afterwards put into sulphuric acid to pickle, so as to be fit to be coated with tin. The water used from the canal comes into it again, and turns the water to a yellowish or rusty colour: this we want to prevent if possible. We want the water to be returned in such a state that the water in the canal will be free from its present colour. We do not want to annoy the owner of the works. Can you inform me how we can neutralise the iron tinge? Can we put a filter-bed, and in the bed put any chemical, &c., that will have the effect desired?—F. G. H.

MEETINGS FOR THE WEEK.

Monday, 4th.—Medical, 8.30. (Anniversary).
—— Society of Arts, 8. "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," T. Bolas, F.C.S.
—— London Institution, 5.
Tuesday 5th.—Civil Engineers, 8.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
—— Zoological, 8.30.
Wednesday, 6th.—Society of Arts, 8. "An Electtric Lamp-lighting System, Mr. St. George Lane Fox.
—— Geological 8.
—— Pharmaceutical, 8.30.
Thursday, 7th.—Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
—— London Institution, 7.
—— Chemical, 8. "Action of Ammonia on Anthrapurpurin," Mr. W. H. Perkin. "Some New Derivatives of Anisoil," Mr. W. H. Perkin. "On Certain Poly-iodides," Mr. G. S. Johnson.
Friday 8th.—Royal Institution, 8. Weekly Meeting. "The Influence of Geographical Circumstances on Political Character," Prof. Goldwin Smith, 9.
—— Astronomical, 8.
—— Quekett Club, 8.
Saturday, 2nd.—Royal Institution, 3. "Carthage and the Carthaginians," R. Bosworth Smith, M.A.

TO CORRESPONDENTS.

George Whewell, F.C.S.—The letter from Dr. Attfield in the present issue renders the publication of yours unnecessary.

Just published, price One Shilling,
TELEPHONES, OLD AND NEW.
A Lecture by Professor BARRETT, M.R.I.A.
With Notes and Illustrations.
London: HORATIO YEATES, Optical and Philosophical Instrument Maker, 33, King Street, Covent Garden.

THE CHEMICAL NEWS.

VOL. XXXVII. No. 954.

NEW PRODUCTS OBTAINED FROM COAL-GAS: PONSCŒLION, A NEW PIGMENT, AND CYANON, A NEW GUNPOWDER.

By LEWIS THOMPSON.

ALTHOUGH the above substances have been obtained from purified coal-gas it must not be understood that the author of these discoveries has any more serious belief in the mischievous results said to arise from the sulphur in gas than he has in the witches of Hopkins or the Popish Plot of Dr. Titus Oates; on the contrary, he is not without a hope that by the progress of real knowledge the existing disgraceful enactments regarding coal-gas will be sent to keep company with the two comparative illustrations above alluded to, and for the sake of science the sooner this happens the better.

It has been proved that the bisulphuret of carbon, like cyanogen, possesses a power of uniting directly with metals without the intervention of oxygen or any similar body, and hence it has received in that form a distinguishing name, "Erythrogen."

Guided by this property an attempt was made to discover whether erythrogen could displace cyanogen from any of its combinations, and in making this attempt, it was not only discovered that cyanogen can be so displaced, but also that in so doing two hitherto unknown compounds are produced, both of which possess very remarkable qualities. The first experiment was made upon a sample of coal-gas known to contain a rather large proportion of bisulphuret of carbon, and it was conducted thus:—A set of Liebig bulbs were charged with a solution of caustic potash, in which a quantity of bicyanide of mercury had been previously dissolved, and the coal-gas in question was then slowly passed through the bulbs with the following results: in a very few minutes the solution became milky, and this continued to increase for several days, with the deposition of a white precipitate, which, however, by a continuance of the experiment, became first grey, then black, and at last of a beautiful scarlet colour, thus proving the existence of at least two, perhaps three, different compounds. It required a great many experiments to discover the nature of these compounds, and also a sure and certain method of making them uncombined with each other; but at length all difficulties were overcome, and the following process adopted:—Having ascertained by analysis that the scarlet compound derived nothing from the coal-gas but the bisulphuret of carbon contained in it, the gas was abandoned, and pure bisulphuret of carbon employed in its stead in this manner. A strong solution of the cyanide of potassium is to be boiled for several minutes upon binoxide of mercury, or, what answers equally well, the nitric oxide of mercury, sold by apothecaries; it is then to be mixed with three times its bulk of a very strong solution of caustic potash, and when it has become cold it must be cautiously decanted into a Florence flask or other convenient vessel, and a considerable quantity of bisulphuret of carbon added to it with frequent agitation. The mixture assumes in rapid succession a variety of tints, passing from white, yellow, brown, and grey, into black, and if then left to the ordinary temperature of the atmosphere the black is changed into scarlet in the course of twenty-four to forty-eight hours, according to the quantity of caustic potash present, the larger the amount of potash the shorter is the time required for the development of the scarlet colour; but this change is very soon brought about by the employment of heat, and therefore the flask containing the mixture should be placed in a water-bath having the temperature of about 110° F., when in about half an hour the scarlet precipitate will have formed in the flask, and we may distil off and collect the surplus bisulphuret of carbon, after which the pigment must be well washed with hot water and carefully dried. As thus obtained, ponscœlion is a scarlet powder of a very brilliant tint, which differs from that of vermilion so slightly that the two substances are very liable to be confounded with each other, but may easily be distinguished by subliming a little of the powder in a small glass tube, when vermilion will retain its red colour, but ponscœlion sublimes and forms a jet-black mass, frequently containing numerous metallic spangles that strongly resemble metallic antimony and tellurium, although it becomes red when finely powdered. The tint of ponscœlion is, however, not so purple as that of vermilion, and a very eminent portrait painter has pronounced it "the nearest approach to the natural hue of the European countenance" that he has ever met with. We may therefore conclude that it will come into general use as a pigment, and hence its qualities become an interesting subject of inquiry, and it is satisfactory to find that ponscœlion rivals gold itself in respect to resisting the effect of atmosphere influences, for it is unacted on by any one of the concentrated acids, even when boiling hot, and it is only attacked like gold by *aqua regia* and those fluids which generate chlorine; it is, moreover, unaffected by sulphuretted hydrogen, or any of the hydrosulphurets, and as a paint may fairly be said to be imperishable. Its composition appears to be very peculiar, though a sufficient number of analyses has not yet been made to settle that question beyond the range of doubt. Nevertheless, it seems to consist of one atom of mercury (202); three atoms of sulphur (48); one atom of carbon (6); and one atom of hydrogen (1); thus making 257 as its atomic equivalent and leading us to conclude that it is a hydro-erythride of the protosulphuret of mercury, from whence we may infer that it might be made by a very different process to that above described, and, indeed, we may naturally expect many improvements in the mode of its production.

For example, if we regard ponscœlion as a hydro-erythride of the protosulphuret of mercury, we might expect to form it by merely precipitating a mixed solution of the erythride and sulphuret of potassium by a solution of the protonitrate of mercury; but this experiment has not yet been tried, although if successful it would be a very economical mode of making the pigment.

We have seen that the first effect produced by passing coal-gas through an alkaline solution of the bicyanide of mercury is to create a white precipitate, and if we arrest the process at that point we obtain in the usual way of washing and drying, a gray-white powder, which, on the application of heat, explodes with much violence, and requires therefore to be examined with care. It has not yet been analysed, and in all probability consists of two distinct substances; one containing sulphur and the other cyanogen united to some form of hydrocarbon; it is to this last that the name "cyanon" has been provisionally given. As procured in the way described, cyanon is a white powder having a greenish grey tint, and when a few grains of it are heated in a test-tube, it explodes at a heat of about 400° F. with much force, and the production of a considerable quantity of soot or carbon, whilst the mercury is thrown out of the tube to a considerable distance, so that cyanon may truly be said to combine the qualities of both gunpowder and shot. The cyanogen compound, which in cyanon is united to mercury, has been transferred to copper with the production of a copper salt having an explosive quality quite equal to the mercurial compound, and in all likelihood this copper salt is the substance which has frequently caused explosions during the repairing of old gas-meters by soldering them. This explosive quality is, however, destroyed by the action of hydrosulphate of ammonia, and no doubt common gas-

liquor would answer the same end, so that it would be a wise precaution to bathe old gas-meters in gas-liquor before attempting to apply a heated soldering iron to them.

To obtain cyanon it is not necessary that there should be an excess of caustic alkali present in the liquor, for this is needed only to ensure the formation of ponsœlion; consequently we have merely to boil a solution of the cyanide of potassium upon an excess of peroxide of mercury, and, after filtering the cold liquor, pass a current of purified coal-gas through it until a sufficient quantity of white precipitate has been formed, which must then be washed and dried in the usual way.

During the above process, as well as in that by which ponsœlion is produced, there are formed acids of an unknown kind, part of which remain in the liquor combined with the potash, and it was my intention to carry out the investigation of these things to their complete elucidation, but a domestic calamity has so shaken my health that this is now impossible, and therefore I leave the subject unfinished.

A few words, perhaps, require to be said in explanation of the term "ponsœlion." It is derived from the ancient Roman name of Newcastle-upon-Tyne, which was Pons Ælii, and as the substance itself was first obtained out of gas made from Newcastle coals, the name can scarcely be objected to as a mere mark of distinction from vermilion, for which purpose alone it is intended.

February 5, 1878.

ON SOME THALLIUM PIGMENTS.

By THOMAS W. SALTER, F.C.S.

AT the International Exhibition of 1871, there was shown a series of thallium colours, made specially by the writer for Messrs. Winsor and Newton, of Rathbone-place. Of these colours, the CHEMICAL NEWS observed:—"Messrs. Winsor and Newton contribute a series of pigments, of extraordinary beauty, prepared from thallium. The specimens include several shades of yellow and orange-red prepared from thallium chromates by the wet way; and green colours, also constituted of thallium and chromium, with a dark brown, a sulphide of thallium."

Previous to the opening of the Exhibition, the following short account of the colours was sent by the writer, on behalf of Messrs. Winsor and Newton, to Professor Abel, F.R.S., Her Majesty's Commissioners' Reporter on Scientific Inventions in relation to Chemistry:—"The range of thallium colours exhibited comprises several shades of yellow, orange, red, brown, and green. The yellow, orange, and red colours are either chromates, bichromates, or terchromates. These were obtained by wet processes, both hot and cold; various precipitants and proportions being employed. Of the two brown colours, the orange-brown, or subdued orange, was prepared by the action of continued heat on the orange bichromate; the other is a sulphide of thallium. The two green colours include a brilliant yellow-green, and a rich olive-green. The former was obtained by partially decomposing the bichromate of thallium with boracic acid; the latter was deposited on adding a mixed solution of a thallium salt and green vitriol to a mixed solution of chromate and red prussiate of potash. By varying the mode of manufacture, thallium colours can be produced bright or subdued, pale or deep, and of different degrees of transparency. At present, the cost of thallium precludes their coming into use as pigments, but it is of importance to the Fine Arts to note all new metals, &c., with a view to testing their fitness for the palette. For the reason stated, the true value of thallium to artists has yet to be ascertained; meanwhile, we have thought the series described would be of interest, as showing the capabilities of thallium, as a source of colour."

To the foregoing may be added Professor Abel's official report:—"The discovery of the metal *thallium*, by Mr. Crookes, through the agency of spectrum analysis, in 1861, created considerable interest at the period of the Exhibition in the following year, when it was first shown in the metallic form by Mr. Crookes. This metal was first discovered in a seleniferous deposit obtained from a sulphuric acid manufactory; it was afterwards found to be very widely distributed, though only in small quantities, in iron and copper pyrites, and also in sulphides of zinc, and was detected in the sulphur, and the copper and zinc obtained from some of these ores. Its properties have since been fully studied, and possess considerable scientific interest; but although somewhat widely disseminated in the mineral kingdom, thallium has hitherto been only found associated in very small proportions with other metals, and there is, therefore, no present prospect of its receiving any useful application. Messrs. Winsor and Newton have indicated one direction, in which the metal, if sufficiently abundant, might be turned to good account, by exhibiting a series of "pigments prepared from thallium." These specimens include several shades of yellow and orange-red, which are thallium chromates, prepared by wet processes, with variations of the nature and proportions of the precipitants employed. There are also some green colours, of which thallium and chromium are constituents, and a dark brown pigment, which is a sulphide of the metal. The value to artists of these and other varieties of pigments which can be furnished by the metal has still to be ascertained."

In his edition of "Field's Chromatography, or Treatise on Colours and Pigments as used by Artists," the writer remarked on thallium colours thus:—

Thallium Yellow.—The new metal, thallium, yields in combination with chromic acid, two yellow colours, a pale and an orange. They are not absolutely insoluble in water, and, the sulphide of thallium being brown, would probably be damaged by impure air. But whatever their properties as pigments may be, their habitudes as such are not yet known. The present scarcity of the metal renders the colours produced from it mere scientific curiosities.

Thallium Red.—The orange-yellow precipitate, formed by mixing a neutral salt of protoxide of thallium with bichromate of potash, is converted by nitric acid into an orange-red. The latter compound, which is a terchromate, is almost insoluble in cold water, 2814 parts being required to dissolve it. If the colour be boiled in a large excess of moderately strong nitric acid, it is dissolved, yielding magnificent cinnabar red crystal on the solution cooling. These crystals, likewise, seem to be the terchromate.

Thallium Orange is produced when bichromate of potash is added to a neutral salt of protoxide of thallium, as an orange-yellow precipitate. The scarcity of the metal precludes their present introduction as pigments, but if the chromates of thallium were found to resist the action of light and air, and not to become green by deoxidation of the chromic acid, they might possibly prove fitted for the palette. It is a question whether their very slight solubility in water would be a fatal objection; and, although they would be liable to suffer from a foul atmosphere, we are inclined to think the effects would not be so lasting as in the chromates of lead. Like lead sulphide, the sulphide of thallium ranges from brown to brownish-black, or grey-black; and, like it too, is subject to oxidation and consequent conversion into colourless sulphate. It is, however, much more readily oxidised than sulphide of lead; and hence the thallium chromates would doubtless soon regain their former hue on exposure to a strong light. Mr. Crookes, who discovered this new metal in 1861, believes that the deep orange shade observable in some specimens of sulphide of cadmium, is due to the presence of thallium. He has frequently found it, he says, in the dark-coloured varieties, and considers the variations of colour in cadmium sulphide to be owing

to traces of thallium. That thallium affects the colour is most probable, but it is not necessarily the cause of the orange hue. The tint of cadmium sulphide is a mere matter of manufacture, seeing that from the same sample of metal there can be obtained lemon-yellow, pale yellow, deep yellow, orange-yellow, and orange-red. With deference to the opinion of a chemist so distinguished, we hold that thallium rather impairs the beauty of cadmium sulphide than imparts to it an orange shade, the thallium being likewise in the form of sulphide, and therefore more or less black. On chromate of cadmium, made with bichromate of potash, thallium would naturally confer an orange hue.

So far as we know, these observations comprise all or nearly all that has yet been written regarding thallium when viewed solely as a source of material colour or pigment. It is proposed to supplement them with some account of the mode of manufacture of the Exhibition colours at first referred to, as well as with some remarks on their value as pigments.

1. *Lemon Yellow* was prepared by adding a very dilute cold solution of ammoniacal chromate of potash to a very dilute cold solution of nitrate of thallium, the resulting precipitate being rendered still paler by subsequent admixture with alumina. The colour was washed with cold water by decantation, collected on a filter, and carefully dried on a white porous tile exposed to a warm atmosphere. This mode of washing and drying was adopted in all cases. As regards the strength of the thallium solution, from 4 to 6 ozs. of the salt were dissolved in 2 quarts of boiling water, the solutions when cold being further diluted if necessary. In one instance where 8 ozs. were so dissolved, the solution deposited crystals on standing a night.

2. *Pale Yellow*.—Here a hot solution of chromate of potash was added to a cold solution of the thallium. It was found that by adding dilute ammonia to the moist washed precipitate, the pale yellow assumed a lemon tint. When dried, the yellow was not thus changed by the addition of ammonia. This pale variety fell more quickly than the deeper yellow and orange sorts, and formed a less bulky precipitate. In the moist state, it was convertible into deep yellow or orange, by the action of more or less bichromate of potash or very dilute nitric acid.

3. *Middle Yellow* was produced by carefully and gradually adding very dilute ammonia to the orange obtained in 5, until the desired tint was arrived at. A more direct way of preparing the colour is to precipitate the thallium solution with a proper mixture of bichromate and chromate of potash. In the first method, chromate of potash may be used instead of ammonia.

4. *Deep Yellow* resulted on precipitating the thallium nitrate with a mixed solution of 2 parts chromate and 1 part bichromate of potash.

5. *Orange Yellow*.—Formed by adding a mixed solution of equal parts chromate and bichromate of potash.

6. *Orange Red*.—Made by mixing hot solutions of thallium nitrate and bichromate of potash. The orange precipitates are more bulky than the deep yellow, just as the deep yellow are more bulky than the pale and lemon. Moreover, they are less easily washed, taking a longer time to settle, and yield more highly-coloured washings.

7. *Red*.—A boiling mixture of equal parts strong nitric acid and water was added to the washed orange-red precipitate, and the solution suffered to remain a night. The crystalline deposit was then washed with cold water and dried without heat. Unless a large quantity of acid be employed, the orange colour is but partly dissolved, and the hot liquid requires decantation, before being set aside. An inferior red was produced by boiling the orange-yellow, with constant stirring, in a mixture of 75 parts strong acid and 10 parts water.

8. *Orange Brown*, or *Subdued Orange*.—By carefully heating the finely ground orange-red powder over sand, the colour assumed a brown or subdued-orange shade. On so heating a mixture of equal parts of orange-red and pale yellow, a brownish or subdued yellow was obtained. When the orange-red was ignited for some time in a porcelain crucible the powder fused and liquefied, becoming solid on cooling and turning out of the crucible in the form of a highly polished mahogany cone, very weighty and very hard. This yielded on grinding a rich orange-brown powder, of a gritty texture.

9. *Green*.—The yellow chromate of thallium was intimately mixed with three times its weight of boracic acid, and carefully ignited in a clay crucible. A small quantity of boiling water was added to the green mass thus formed, the colour being afterwards washed with cold. By varying the proportions, either a ~~yellow~~, yellow-green, or blue-green may be produced, according as the chromate is more or less decomposed.

10. *Olive Green*.—A mixed solution of thallium nitrate, with half its weight of green vitrol, was added to a mixed solution of chromate of potash, with half its weight of red prussiate.

11. *Brown*.—This was precipitated from a cold solution of thallium, by somewhat dilute sulphide of ammonium. Another brown is formed when a mixed solution of caustic potash and red prussiate is added to the thallium nitrate.

Without going into minute detail, such is a brief description of the processes employed in the manufacture of the twelve preceding colours or pigments; some of which, it was afterwards found, were merely colours, and not fitted for pigments. A pigment is necessarily a colour, but a colour is not of necessity a pigment. To be a good pigment, a colour must possess certain physical, chemical, and artistic advantages; but, to be a pigment at all, a colour must needs be physically qualified. Wanting in this respect, the following colours must be expunged from our list of thallium pigments:—the red, by reason of its too crystalline nature; and the green, olive green, and orange brown obtained by ignition, owing to a tendency of the yellow contained in them to separate and float on the surface.

As a rule, the stability of a colour is more severely tried in water than in oil, and on this account the former was selected as the trial medium. It may be remembered that, the sulphide being more or less brown or black, the writer conjectured that the chromates "would be liable to suffer from a foul atmosphere." Strange to say, experiment proved this conclusion to be wrong, showing—not for the first time—how liable are theory and practice to clash in the case of colours. A range of water-rubs of thallium chromates, and a water-rub of white lead, were shut up in a room filled with sulphuretted hydrogen gas, with the result that, while the lead was completely blackened, the colour of the chromates was quite unchanged. As regards exposure to light and air:—the *Lemon Yellow* altogether lost its brilliant purity of hue, assuming a blackish-green shade; the *Pale Yellow* similarly suffered to a less extent; the *Middle Yellow* lost its beauty in a still less degree; the *Deep Yellow* became somewhat dull; the *Orange Yellow*, *Orange Red*, and *Orange Brown* were scarcely altered; the *Green* changed from a yellow-green to a blue-green; the *Olive Green* blackened in hue; while the *Brown* became whitish and chalky in the dark portion of the rub, partly disappearing in the middle, and wholly vanishing in the thin wash.

Pure, brilliant, of good body, working well, and entering kindly into admixture, the deep yellow and orange chromates of thallium might fairly lay claim to a place on the palette, but for the presence there of superior and far cheaper pigments of the same class of colour. With the deep yellow and orange cadmium sulphides at hand, however, the introduction of thallium chromates would be superfluous, even if their excessive costliness were not a bar to commercial success.

St. John's Cottage, New Wandsworth, S.W.,
Feb. 15, 1878.

ON THE SOLUTION OF MOLYBDATE OF AMMONIA IN NITRIC ACID.

By SERGIUS KERN, M.E., St. Petersburg.

JUNGCK (*Fresen. Zeits*, xv., p. 290) remarked that the yellow precipitate, formed in the so-called "molybdic solution," used for the precipitation of phosphoric acid, is due to the action of light on this solution, and is a metameric form of molybdic acid. This precipitate is easily soluble in ammonia, and contains no phosphoric acid. If the molybdic solution is kept in dark green bottles, the yellow precipitate is also formed, but in rather small quantities. On the exposure of the solution to sunlight for some hours, a turbidness is remarked in the liquor, and finally a yellow precipitate falls down. But Uelsmann asserts that even direct sunlight has no action on the molybdic solution (*Fresen. Zeits.*, xvi., p. 52.) Having often remarked the formation of a yellowish precipitate in the bottles used for the molybdic solution, the author also made, some months ago, experiments in this direction.

The molybdic solution was prepared as ordinarily. If the molybdic acid, used for the preparation of ammonia molybdate is free from phosphorus, no yellow precipitate is formed at once or in some hours.

In such pure molybdic solutions, containing no traces of phosphorus, a yellow-white precipitate is remarked, after standing for several weeks, especially if the bottles are often opened. Every opening of the bottle allows a certain quantity of ammonia to fly away. The precipitate is the basic molybdic salt, and not a metameric form of molybdic acid.

The action of light on pure molybdic solution was examined by placing equal quantities of such a solution (50 c.c.) into white and black bottles; the first was then exposed to the action of sunlight.

In one month a notable quantity of the yellowish-white precipitate was found in the two bottles. The white bottle contained, however, a greater quantity of the precipitate. These precipitates contain no phosphorus, and dissolve easily as already remarked in ammonia.

The quantity of this precipitate formed depends much upon the *modus operandi* adopted while preparing the molybdic solution, Eggertz's method being the best.

COLOURED CRYSTALLINE COMPOUNDS OBTAINED FROM BRUCINE.

By DAVID LINDO.

IT has long been known that deoxidising agents, such as protochloride of tin, and sulphide of ammonium, when added to a heated mixture of brucine and nitric acid, give rise to a deep violet colouration. On one occasion having used sulphurous acid as the reducing agent to produce this effect, the tube containing the mixture was left at rest for some hours, when, on examination, it was found that a few violet coloured crystals had subsided. This substance is the nitrate of a blue coloured base, which is very unstable, absorbing oxygen from the air the moment it is liberated from its salts.

There is no difficulty in obtaining the nitrate in considerable quantities. I heat brucine with a moderate quantity of concentrated colourless nitric acid, add a little water, boil until the colour changes to yellow, then add a strong solution of sulphurous acid in excess. A mass of violet coloured crystals, in the form of minute needles, separates as the solution cools. They are thrown on a filter, washed first slightly with water, then with alcohol, and dried on the water-bath. A yellow crystalline compound (the nitrate of another base) is also easily obtained from brucine by the action of nitric acid. It is probable this substance has been already described by Strecker, under the name of Cacotheline. In order to obtain it, I act on brucine with nitric acid, as above, let the mixture cool a little, then add a considerable volume of alcohol. The yellow compound immediately separates in the form of minute crystals. It is washed with alcohol, and dried on the water-bath. These two coloured compounds are readily converted into each other by the addition or abstraction of oxygen.

The violet salt dissolves sparingly in cold, more freely in hot water, to a solution of the same colour. It is insoluble in alcohol. If the aqueous solution is exposed to the air, it gradually absorbs oxygen, and is converted, after some hours, into the yellow compound which remains in solution. Powerful oxidising agents produce this change at once. The addition of sulphuretted hydrogen, sulphide of ammonium, or other deoxidisers restores the violet colour. If sulphurous acid is employed for the purpose it is generally necessary to apply heat. If a small quantity of the violet crystals is placed in a porcelain basin, and treated with a few drops of strong solution of potash or soda, the base is released, and dissolves in the alkali with the production of a magnificent and intense blue colour, which, however, quickly changes to yellow, the two colours mixing produce a beautiful green. The reaction is very delicate. The yellow salt is sparingly soluble in cold water, more freely in hot water. The solution is of a bright amber colour. It is insoluble in alcohol. The addition of sulphuretted hydrogen to the aqueous solution immediately converts it into the violet salt.

Other reducing agents, of course, produce the same result.

Falmouth, Jamaica, Feb. 1, 1878.

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.*

By H. CARRINGTON BOLTON, Ph.D.

(Continued from p. 87).

DECOMPOSITION OF MINERALS BY ORGANIC ACIDS AND OXIDISING AGENTS.

18. DESIROUS of extending the use of organic acids in attacking minerals, we tried the effect of adding oxidising agents to the solution of the acid; the results were satisfactory and prompted the following investigation.

When potassium, sodium, or ammonium nitrate is added to a boiling solution of citric acid, on reaching a certain degree of concentration nitric acid is set free, and this immediately reacts upon the organic acid, decomposing it with evolution of gases. These gases proved on examination to consist of nitric oxide and carbonic anhydride; whether carbonic oxide is present was not determined. The reaction which takes place is very complex; it may possibly be expressed thus:—

$$4H_3C_6H_5O_7+6KNO_3=$$
$$=7H_2O+3K_2HC_6H_5O_7+6CO_2+3N_2O_2$$

or admitting the formation of oxalic acid,† we may write:=

$$11H_3C_6H_5O_7+16KNO_3=$$
$$=8K_2HC_6H_5O_7+3H_2C_2O_4+17H_2O+12CO_2+8N_2O_2$$

Potassium nitrite also decomposes citric acid in a somewhat similar manner, the action beginning in the cold and continuing with violence and a rise of temperature. The reaction may be expressed as follows:—

$$9H_3C_6H_5O_7+16KNO_2=$$
$$=8K_2H.C_6H_5O_7+H_2C_2O_4+3H_2O+8N_2O_2+4CO_2.$$

* Read before the New York Academy of Sciences, April 30, 1877.
† "Watts's Dictionary," i., 996.

Or, abbreviating and disregarding the decomposition of the organic acid, we may have

$$H_3\bar{C}+3KNO_2=K_3\bar{C}+HNO_3+H_2O+N_2O_2.$$

The nitric acid being then in a nascent condition is prepared to effect oxidation in a most powerful manner.

When chlorate of potassium is substituted for the nitrate or nitrite, the decomposition begins on boiling down the solution to small bulk, and proceeds very vigorously, the carbonic anhydride disengaged being accompanied by a gas having an excessively irritating odour and exciting tears. This peculiar substance is probably the same as that obtained in 1847 by Plantamour,* by the action of chlorine on sodium citrate, and which was subsequently studied by Laurent, by Staedler, and by Cloëz.† The latter showed the irritating body to be perchlorinated acetate of methyl, $C_3Cl_6O_2$, and explains its formation as follows:‡

$$H_3C_6H_5O_7+H_2O+16Cl=C_3Cl_6O_2+3CO_2+10HCl.$$

Precisely how the action proceeds with potassium chlorate and citric acid we have not determined; it is undoubtedly more complex than even the following equation indicates:—

$$26KClO_3+27H_3C_6H_5O_7=$$
$$=3C_3Cl_6O_2+45CO_2+45H_2O+8KCl+18KH_2C_6H_5O_7.$$

Tartaric acid behaves exactly like citric acid with the nitrate and the chlorate. Oxalic acid decomposes them in very concentrated solutions and attacks the nitrite very actively, probably in the following manner:

$$2KNO_2+3H_2C_2O_4=2KHC_2O_4+2H_2O+2CO_2+N_2O_2.$$

Acetic and formic acids do not decompose the nitrate nor the nitrite.

19. These interesting reactions enable us to attack many mineral sulphides with the greatest ease. With potassium nitrite and citric acid, they are decomposed in the cold; with the nitrate and chlorate, only on boiling. Pyrites, for example, in fine powder, is very quickly decomposed by these powerful agents, and completely dissolved, save a little sulphur. The solution contains ferric sulphate and hydropotassium citrate, while both nitric oxide and carbonic anhydride are evolved abundantly; the reaction then may be formulated as follows:—

$$4FeS_2+26KNO_3+12H_3C_6H_5O_7=$$
$$=2Fe_2(SO_4)_3+2K_2SO_4+11K_2H.C_6H_5O_7+15H_2O+$$
$$13N_2O_2+6CO_2.$$

Of the eighteen sulphides selected for examination, all but two, molybdenite and cinnabar, are readily decomposed by heating with citric acid and potassium nitrate; stibnite and bournonite yield clear and colourless solutions; argentite and galenite, turbid and colourless solutions; bornite, sphalerite, chalcocite, pyrrhotite, niccolite, smaltite, pyrite, chalcopyrite, ullmannite, marcasite, arsenopyrite, and tetrahedrite give coloured solutions not particularly characteristic. The copper minerals, heated with a large proportion of the organic acid, give precipitates of red oxide of copper. The sulphur in these minerals is not completely oxidised by the potassium nitrate, and a part floats in the solutions.

Parallel experiments with citric acid and potassium chlorate gave similar results, but the action of the chlorate is slower. Tartaric acid may be substituted for citric, and appears to differ little in its solvent power.

20. Although oxalic acid decomposes potassium nitrate, only in the most concentrated solutions, yet the presence of an oxidisable body like pyrites incites a reaction which effects complete decomposition of the sulphide, precisely as with citric acid. Potassium nitrate and oxalic acid heated together give the following reaction:—

$$2KNO_3+5H_2C_2O_4=2KHC_2O_4+4H_2O+N_2O_2+6CO_2;$$

and on the addition of pyrites we have:

$$2FeS_2+12KNO_3+13H_2C_2O_4=$$
$$=Fe_2(SO_4)_3+K_2SO_4+8H_2O+10KHC_2O_4$$
$$+6N_2O_2+6CO_2.$$

Since, however, the nitric oxide is evidently evolved in much greater proportion than the carbonic anhydride, the following equation probably expresses the actual reaction with greater accuracy:—

$$6FeS_2+32KNO_3+29H_2C_2O_4=$$
$$=3Fe_2(SO_4)_3+3K_2SO_4+26KHC_2O_4+16H_2O$$
$$+16N_2O_2+6CO_2.$$

To decompose sulphides with oxalic acid and potassium nitrate, the best results are secured by boiling the two reagents together for a short time, and then adding the finely pulverized mineral; a violent action sets in immediately. In studying the *rationale* of the above-named decompositions, we discovered that many sulphides are attacked by an aqueous solution of potassium nitrate (and nitrite) without the addition of acid; this unexpected result explains satisfactorily the violence of the decomposition of the sulphides by the mixture of reagents, many forces being simultaneously brought into play; the organic acid, while able to decompose the potassium nitrate alone, acts at the same time as a solvent of the products resulting from the decomposition of the sulphide by the nitrate.

This explains also the fact that the comparatively weak acids—malic, acetic, and formic—which do not of themselves decompose potassium nitrate, are able to dissolve the sulphides in the presence of the latter reagents. We are now investigating the behaviour of certain minerals with these and other saline solutions, and hope to present the results in a future paper.

We have applied this method of attack to several other classes of minerals, but without much advantage. The oxides of iron, magnetite, and hematite, as well as franklinite and chromite, resist the combined action of the mixed reagents. The decomposition of silicates is not notably facilitated. Limonite is feebly attacked. Uraninite, however, dissolves completely and rapidly in this mixture of reagents.

The remarkable solvent power of a mixture of nitrate of potassium and citric acid is further demonstrated by the fact that metallic copper, silver, lead, tin, bismuth, and antimony, as well as magnesium, iron, and zinc, dissolve therein with more or less rapidity.

Aluminium resists this mixture of reagents:—the alchemists' dream of an *alcahest*, or universal solvent, is therefore only partly realised.

(To be continued.)

* Berzelius, *Jahresbericht*, vol. xxvi. p. 428.
† *Annales de Chimie et de Physique*, (3) xvii, 297 and 311
Cf. "Watts's Dictionary," I 996

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

March 2, 1878.

Professor W. G. ADAMS, President, in the Chair.

THE following candidates were elected Members of the Society:—Mr. J. P. Kirkman and Dr. W. J. Russell, F.R.S.

Mr. SEDLEY TAYLOR exhibited the colours produced in thin films by sonorous vibrations. A piece of thin brass perforated with a triangular, circular, or rectangular aperture, and bearing a thin film of soap solution, was placed horizontally on one end of an L-shaped tube: the beam of the electric lamp, after reflection from it, was received on a screen. It was shown that, when a sound is emitted in the neighbourhood of the open end of the tube, the film takes up a regular form, which is indicated by the different colours of the reflected light, and each note has its own particular colour figure; and, further, with different instruments we have different figures. Thus, when a square film was

employed, a kind of coloured grating was the result, which was modified by changing the note, and with a circular film concentric rings traversed by two bars at right angles were observed.

Mr. W. H. PREECE exhibited and described the Phonograph. After referring to the manner in which the preceding communication bore on the subject of the telephone, he went on to explain the construction of the two instruments exhibited, which have been made in accordance with the published accounts of the apparatus and details received from the inventor, M. T. A. Edison, by Mr. Pidgeon and Mr. Stroh respectively. In the first of these the receiving and emitting discs are distinct, the former being of ferrotype-iron and the latter of paper, whereas in the second form of apparatus both these functions are performed by one and the same disk of iron. They also differ in that in Mr. Pidgeon's apparatus the drum receives its motion by hand, and in that of Mr. Stroh a descending weight is caused to communicate motion by a suitable train of wheels, which motion can be controlled and regulated by an adjustable pair of vanes. In both cases the drum is of brass, traced over by a spiral groove, and the whole is mounted on a screw of the same pitch. The manner of using the phonograph is extremely simple. The drum having been covered with tin-foil, a uniform movement of rotation is given to it, and a fine metal point, firmly fixed to the centre of the receiving-plate, is brought in contact with it, care being taken to place the point accurately over the groove. If now this plate be sung or spoken to, the tin-foil will be indented in accordance with the vibrations communicated to the plate. The emitting-plate having been provided with a resonator, its point is now brought into the position initially occupied by the point of the receiving-plate, and, on rotating the drum with the same velocity, fairly identical sounds are given out. It will be seen that Mr. Stroh's apparatus has an advantage over that of Mr. Pidgeon in that it secures a constant rate of rotation; but, on the other hand, the sounds emitted by the paper disk appeared to be more distinct than those from the iron. A number of experiments were performed with the instruments. The sounds were reproduced at times with remarkable distinctness, and when Mr. Spagnoletti and Mr. Sedley Taylor sang "God Save the Queen" as a duet through a double mouthpiece, the two voices could be clearly distinguished on its being reproduced. It was shown that even when an indented sheet of tin-foil has been employed to emit sounds, it retains its form with such perfectness that the sounds can be reproduced by means of it a second and even a third time with nearly equal distinctness.

Prof. GRAHAM BELL pointed out that the articulation of the instruments was very similar to what he had observed in the earlier forms of the telephone, and he had no doubt, judging from his own experience of that instrument, that the phonograph will ere long be so adjusted as to articulate much more perfectly. He anticipated that the *quality* of the sound would be found to vary as the rate of rotation was altered, as well as the pitch, and this proved on experiment to be the case.

EDINBURGH UNIVERSITY CHEMICAL SOCIETY.

Sixth Meeting, Februarv 27, 1878.

W. INGLIS CLARK, B.Sc., in the Chair.

A PAPER was read on *Electrolysis*, by R. M. MORRISON, D.Sc., Chemical Demonstrator of the University, in which he traced the history of *Electrolysis* down to the present time, showing that in 1840 the art was practically in its infancy, and that at the present day it was in numberless ways made use of. The chief points of theoretical and practical interest were dwelt upon, both with regard to the various metals which could practically be used, and to the solvents form which the best results were attainable.

NOTICES OF BOOKS.

The London Water Supply, being a Report submitted to the Society of Medical Officers of Health on the Quality and Quantity of the Water supplied to the Metropolis during the past Ten Years. By C. M. TIDY, M.B., M.S., &c. London: J. and A. Churchill.

IN this report the author considers the important question "Is the present water-supply of London pure and wholesome?" and answers it in the affirmative. He points out, in our opinion very justly, that the purely chemical point of view must here be regarded as merely subsidiary to the medical. He remarks that "The Kent Company's water, although reported to be loaded with 'previous sewage contamination,' is undoubtedly of excellent quality; nevertheless, although I have most diligently considered and compared the death-rates, and also, as far as possible, the causes of death of different parts of the metropolis supplied by the Thames water, the Lea water, and the water from the chalk-wells of the Kent Company respectively, I have failed to discover any difference worth noting in the death-rates, or any evidence whatsoever that any special class of disease has been prevalent from drinking the waters of the Thames and Lea, or absent from the use of the chalk-water. Indeed, what differences exist are in favour of the Thames and Lea waters, over that of the chalk-wells."

Dr. Tidy quotes, from the "Sixth Report of the Rivers' Pollution Commission" (p. 275, three lines from bottom), a passage which he says "we may well be amazed to read." The Commissioners say—"The supply of such water (*i.e.*, the Kent Company's) to the metropolis generally would be a priceless boon, and *would at once confer upon it absolute immunity from epidemics of cholera.*" On this he very appositely remarks—"If there had been one medical man upon the Board such words would never have been written. We who know how little is known of the cause of such epidemics, how they come amongst us even when we think our defences most secure, how little able we are to cope with them when they are in our midst, may fairly stand aghast when those who are outside our profession, and have never had to fight the battles we have had to fight with disease, have been rash enough to commit such words as these to paper. The members of that Commission, laying claim, as it would seem, almost to prophetic power, or at any rate to a knowledge positively superhuman, have drawn what I may venture to designate as a very violent conclusion."

Dr. Tidy has laid his finger on the fundamental error in the original constitution of the Commission. We should have naturally expected that an inquiry into a chemical question, with its bearings upon public health would have been entrusted to a joint commission of chemists and physicians. On the contrary, it comprehended only one chemist, and no medical man. The part played by engineers in sanitary questions is strictly analogous to that which devolves upon the cutler and the potter in the preparation of our food.

The processes used by Dr. Tidy in the analysis of his samples of water may require some little notice. He records his adherence to the permanganate process, "every year's experience only confirming its accuracy as a qualitative test." Of the Frankland-Armstrong process the experience of the last two years compels him to speak more favourably than on previous occasions. In the "albumenoid ammonia process" as a test of purity his faith is very small. He adds that "the results obtained by the permanganate and by the combustion processes closely agree, whereas the results obtained by Mr. Wanklyn's process seldom correspond, and are often at direct variance with both the permanganate and the combustion processes." We may here remark that we scarcely see how the results of a process like the "permanganate," which professes to indicate the gross amount of organic

matter in a lump, and which is further acted upon by certain inorganic matters, can be said either to agree with or to vary from the results of another which aims at determining the nitrogen only. The permanganate of potassa at ordinary temperatures and in dilute solution has very little action upon living organic matter, which is considered the most dangerous impurity. We have seen "moving organisms" retain their activity for many hours in water to which a large excess of permanganate had been added, and should therefore expect that they would escape immediate oxidation, and consequently fail to tell upon the result. Dr. Tidy's opinion, based as it is upon wide and prolonged experience in conjunction with the late lamented Dr. Letheby, is, however, entitled to great weight, and it must be admitted that the inorganic impurities which sometimes vitiate the results of the permanganate process are certain not to occur in the London waters.

Whilst holding that the supply of water to a great city is not a task that can safely be entrusted to private enterprise, freed from the salutary check of competition and invested with a perpetual monopoly, we gladly record our opinion that the work before us is a valuable and thoroughly practical contribution to English sanitary literature.

CORRESPONDENCE.

ILLUMINATING POWER OF BENZOL, &c.

To the Editor of the Chemical News.

SIR,—What I meant to criticise in my former letter was Dr. Frankland's verbal communication to the Chemical Society, as reported in the CHEMICAL NEWS of Jan. 28. At the time when I wrote it was perhaps a little rash of me to simply assume that the reporter substantially reproduced what the Doctor said, but since then that report has been fully confirmed by Dr. Gerstl in his letter to the *Berichte der Deut. Chem. Gesell.*, and, besides, Dr. Frankland does not impugn its correctness. Hence I now feel assured that his report is correct, and, more especially, that the sentence which I quoted between inverted commas does reproduce the very words of the speaker. With the memoir which Dr. Frankland is going to *print* I can have nothing to do. If in it he means to substitute "hydrocarbons which combine with sulphuric acid" for the words "*benzol, ethylene, propylene, butylene, and acetylene*," which he used at the meeting, why it only proves that Dr. Frankland does not care to re-assert before the whole of the scientific world what he has already asserted before the Chemical Society.

Dr. Frankland says that he collected bags full of marsh-gas from a marsh near Manchester, and showed the non-luminosity of fish-tail flames fed with it to a large audience at the Royal Institution. To this my "inner consciousness" adds that, at the same lecture, the Doctor showed the combustion of a piece of phosphorus in oxygen. Does it follow that he was the first to observe the brilliant luminosity of burning phosphorus? But really, it is scarcely worth while now to enquire who it was that first observed that a fish-tail consuming marsh-gas is almost non-luminous, since I have proved that even ethylene—*as a constituent of ordinary coal-gas*—is "non-luminous" in the same sense (though of course not in the same degree) as marsh-gas.

Is there any need of my specially affirming that I never suspected Bunsen or any other chemist of being *ignorant* of the presence of benzol in coal-gas? According to *my* knowledge of English, "*ignoring*" a thing does not mean to be "*ignorant*" of it; and all I said of Bunsen was that (in his method of coal-gas analysis) he "*ignored*" the presence of benzol, and did not even find it worth reporting as being included in the "C_2H_4" and "C_4H_8;' for the very same reasons as those that caused Dr. Frankland (in his analyses of 1852) to simply determine the carbon vapour present in forms absorbable by vitriol, without discriminating between benzol-carbon and olefine-carbon.

It is quite true that somewhere in my paper I say "There *is* room for a little benzol." But these words, as every body sees, are used only as formulating the result of a re-calculation of part of the coal-gas analysis which Bunsen gives in his "Gasometrishe Methoden." It also is true that I *did* express in my paper a doubt as to whether coal-gas, as used by the consumer, can possibly contain more than a minute fraction of the benzol which was present in it when it left the retort. But this is not, as Dr. Frankland insinuates, a "*vague impression*," but a legitimate conclusion from experiments which *proved* that benzolated hydrogen, when kept over water, soon loses the better part of its luminosity (and accordingly of its benzol), and from my analysis of the bromides which I had extracted from Glasgow gas, and which turned out to consist, *substantially*, of $C_2H_4Br_2$ mixed with a little of the next higher homologues.

If, notwithstanding these results, I pronounce it "highly probable that the light-value of a coal-gas depends far more on the proportion of benzol" (small as it is) "than on the proportion of olefines which it contains," this "vague impression," again, is founded upon experiments which proved that, for equal quantities of carbon-vapour per unit-volume of gas, benzol is infinitely more luminous than etyhlene. What good would it have done if I had determined, photometrically, the exact ratio of the luminosities of the two flames, and calculated it to so and so many decimal places? Probably, in Dr. Frankland's eyes, this would have turned the "vague impressions" into a piece of "exact science." In my mind exact science is nothing more nor less than correct observations and close logical reasoning founded upon these and upon established propositions.—I am, &c.

W. DITTMAR.

Anderson's College,
February 19, 1878.

CHEMISTS AND CHEMISTS.

To the Editor of the Chemical News.

SIR,—For myself, I have no doubt as to the accuracy of the statements made by my friend Professor Attfield, or why should he have asserted them so confidently; and that it now only remains for some ingenious historian to show that the designations of poet, painter, &c., pertain primarily to dealers in other people's poetry and paintings. Still, the conclusion being thus remarkable, would Professor Attfield, out of consideration for those perverse persons who will not accept statements on authority, however eminent, kindly give your readers the dates and references on which he relies, concerning the earliest recorded use of the word "chemist," as applied distinctively to the worker in chemicals, in substitution of the older word alchemist; and as applied distinctively to the dealer, or retailer, or dispenser of chemicals in association with the word "druggist"—of course, "distinctively" to satisfy doubters of the distinctive priority of the druggist's claim. His letter need not be long or elaborate—just a reference to the passages, &c., he had in his mind will, I am sure, carry conviction.—I am, &c.,

A CREDULOUS CHEMIST.

London, March 5, 1878.

Royal Institution of Great Britain.—At the general monthly meeting of the above Institution, held on Monday last, the special thanks of the members were given to Warren De la Rue, Esq., D.C.L., for his donation of fifty pounds for the benefit of the Chemical Laboratory.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 5, February 4, 1878.

New Observations on the Chemical Reactions of the Electric Effluve and upon Persulphuric Acid.—M. Berthelot.—Persulphuric acid being formed in the reaction of sulphurous acid upon oxygen it was natural to think that the same compound might be obtained directly by means of anhydrous sulphuric acid, and the supposition has been verified by experiment. Having introduced into an effluve tube 277 milligrms. of anhydrous sulphuric acid contained in a phial tube, the author closed the tube, filled it with dry oxygen (about 60 c.c.) and caused the effluve to act upon it at high tension for eight hours. The bottom of the tube was then heated to disperse certain small opaque masses of anhydrous sulphuric acid not yet attacked, and the effluve was again allowed to act upon it for some hours. At the end of this time the sulphuric acid had disappeared, and in its place was a substance having the aspect of persulphuric acid. The volume of gas which had disappeared was rather more than 20 c.c. at 12°. The product obtained was really persulphuric acid, as it yielded to a standard solution of ferrous sulphate a weight of oxygen equal to 26·2 m.gr. or 9·5 per cent in relation to the sulphuric acid, while theory requires 10·0. The author then examined if any reaction takes place between anhydrous sulphuric acid and dry oxygen left in contact in a tube otherwise quite similar for ten days without being submitted to the action of the effluve. The result was negative. The persulphuric acid when prepared does not possess an indefinite stability when the action of the effluve is suspended. After some days the fine crystalline needles obtained at first after a few days are resolved into a sort of attenuated snow, which seems to be a combination of sulphuric and persulphuric acids. A similar substance is produced in the outset when the effluve is allowed to act upon anhydrous sulphuric acid in presence of oxygen, and it may hence be regarded as an intermediate product. It appears therefore that persulphuric acid as well as ozone and oxygenated water undergoes spontaneously a gradual decomposition when the foreign energy, under whose influence it has taken its rise, ceases to act, that is, to communicate to the matter a special condition and a particular kind of movements or vibrations. The formation of persulphuric acid requires a notable excess of oxygen. If merely the quantities indicated by the equivalents are employed the reaction remains incomplete. This circumstance is explained if we remark that the effluve exerts a double action, both decomposing and combining. In general, binary compounds submitted to the action of the effluve are not simply resolved into their elements, but one portion is decomposed whilst another portion forms more complex compounds. Thus sulphuretted hydrogen yields hydrogen, sulphur, and hydrogen polysulphide. Such phenomena of equilibrium between decomposition, pure and simple, and the formation of complex and condensed compounds are not only met with in the study of reactions brought on by the act of electrisation, but they are observed also in reactions induced by the action of heat and of light. The equilibria accompanying such electric, pyrogenic, and photogenic synthesis present one common character: they express the result of two conflicting energies—the chemical energy, which tends to realise among bodies the reactions (combinations, condensations, or sometimes decompositions) capable of liberating the greatest amount of heat, and, on the other hand, the thermic, luminous, or electric energy, which tends to provoke the contrary reactions—those accompanied with absorption of heat.

Definite Hydrates formed by the Hydracids.—M. Berthelot.—The author gives the following as a list of the simplest hydrates:—1. $HCl+H_2O_2$ answers to $S_2O_8H_2+H_2O_2$ crystallised, and perhaps also to the sub-hydrate $KH_2O+H_2O_2$, but it has not been isolated. 2.—$HCl+2H_2O_2$, liquid and crystalline. Its formation liberates in the liquid state +11·6 cal.; in the solid state about 14·1 cal. $HBr+2H_2O_2$, liquid and crystalline. Its formation liberates in the liquid state +14·2. The hydrates containing a proportion of water higher than $2H_2O_2$ are only known in the liquid state, their melting-point being above −35°. 3. $HI+3H_2O_2$. Its formation in the liquid state liberates +15·6 cal. 4. $HBr+4·5H_2O_2$, liquid, evolves +17·5. $HI+4·5H_2O_2$, liquid, evolves +17·0. 5.—$HCl+6·5H_2O_2$, liquid, evolves +14·0.

The Vibrations of Matter and the Waves of the Ether in Phosphorescence and Fluorescence.—M. Favé.—The author ascribes phosphorescence and fluorescence to the vibrations of the phosphorescent or fluorescent body propagating in the ether waves of an intensity sufficient to affect the eye, especially when this organ is for the time being withdrawn from the action of the waves which act habitually upon it.

On the Dark Rays of the Solar Spectrum and the Constitution of the Sun.—A. Cornu.—The position and the relative brightness of the solar spectrum are explained by the action of an absorbent stratum existing upon the sun, a stratum whose composition is analogous to that of volatilised aërolites.

Refraction of Gases and Vapours.—M. Mascart.—The new results obtained by the author are:—

	Refraction with Relation to that of Air.
Chlorine	2·63
Bromine	3·85
Hydrochloric acid	1·52
Hydrobromic ,,	1·95
Hydriodic ,,	3·10
Hydrocyanic ,,	1·49
Sulphhydric ,,	2·12
Ammonia	1·29
Water	0·88
Phosphorus protochloride	5·92
Carbon sulphide	5·05

Repulsion Resulting from Radiation.—W. Crookes.—Presented by M. Th. du Moncel.—For several years I have been pursuing my researches on the repulsive force resulting from radiation transmitted through rarefied gases. The apparatus I used consisted of a torsion balance, in which the beam for carrying the experimental disks is a straw suspended by a very fine glass fibre. Six disks, each differing from each other, are suspended from one end of this beam, and they are balanced at the other end by a suitable counterpoise. A standard candle, placed at a fixed distance from the balance, supplied the radiation, and the displacements produced by this radiation were increased on a graduated scale by a ray of light reflected from a mirror. A screen was so arranged that the light might fall on any disk selected for experiment without the others being affected. Finally, a standard lampblacked disk was placed in the apparatus in order that the results might be compared. All the apparatus was carefully sealed and attached to a mercury pump capable of carrying the exhaustion to any desired point. My experiments have extended over one hundred different substances, and I have measured the effect produced by them, not only under the influence of simple radiation from a luminous source, but also by removing the invisible heat rays by the interposition of a water screen. In this manner I found that each substance exercises a more or less distinct action on the absorption of rays. Thus most white powders powerfully absorb the invisible heat rays, while they are almost without action on the luminous rays.

On the contrary, the black powders powerfully absorb the luminous rays and only slightly absorb the obscure heat rays whatever their intensity may be. The different metals present great differences in their action. Iron, for instance, chiefly absorbs the invisible heat rays, while gold is principally acted on by the luminous rays. The substances I have experimented with may be divided into two classes: 1st. Those whose action is increased by the interposition of water screens with regard to the effect produced on the standard disk; 2nd. Those in which the contrary is the case. Amongst the former may be mentioned copper tungstate, saffranin, precipitated selenium, and copper oxalate; these are more affected by light than by invisible heat. Amongst class 2 may be mentioned chromic oxide, persulphocyanogen, zinc oxide, barium sulphate, and calcium carbonate; these are acted upon more by the ultra-red rays than by the luminous rays. Remarkable effects may be obtained by combining the substances in these two categories on the disk of the radiometer. Thus, if we alternately coat these disks, which we will suppose to be made of pith, with chromic oxide and precipitated selenium, the radiometer will be seen to turn in one direction when it is exposed to the light of a candle, and the contrary way when a water screen is interposed before the luminous source. A similar radiometer, the vanes of which are coated with saffranin and hydrated zinc oxide, does not move at all when it is directly exposed to the flame of a candle, but will be set in motion as soon as a water screen is interposed. In a note which I have had the honour of presenting to the Academy of Sciences I have shown that when the exhaustion of a radiometer is carried beyond a certain limit its sensibility gradually diminishes until it became absolutely null. I have entered more deeply into this question, and have come to the conclusion: 1st. That there is a gradual increase in the sensitiveness of the radiometer until the pressure has attained 50 millionths of an atmosphere (0·038 millim.); 2nd. That beyond this limit to 30 millionths of an atmosphere (0·013 millim.) it remains stationary; 3rd. Further still, it sinks rapidly until at 1 millionth (0·00076 millim.); 4th. That at 0·2 millionth of an atmosphere (0·00015 millim.) the radiometer refuses to turn even when five candles are put near it. To examine the effects of molecular pressure produced directly by heat upon a radiometer I arranged, besides the system of vanes suspended horizontally, a ring of platinum which could be rendered incandescent by an electric current. The vanes were of transparent mica, and were inclined to each other like the sails of a windmill, and above these vanes was a mica disk, which turned on a separate pivot. The normal direction of this disk was naturally inverse to that of the system of vanes. The following are the results I obtained:—(1.) When the apparatus is full of air at the normal pressure of 760 m.m., and the platinum ring was incandescent, the direction of the rotation of the vanes and disk was *positive*, that is to say, that which would be produced by a current of air coming from the platinum ring: this effect must be attributed to the ascending current of hot air. (2.) At a pressure of 80 millims. the disk did not turn. The vanes turned slowly in the positive direction. (3.) At 19 millims. no movement was produced either by the disk or by the vanes. (4.) At 14 millims. the disk remained stationary, but the vanes began to turn gently in the negative direction, that is to say, in a way inverse to their first direction. (5.) At 1 millim. the disk turned in a continuous manner in the positive direction, whilst the vanes turned rather fast in a negative direction. (6.) At 0·224 millim. the speed of the disk or the vanes was the same, and their rotative movement was the same. Below the pressure the speed of the rotation of the vanes diminished gradually, whilst the speed of the disk increased, and at a pressure of 0·107 millim. the disk turned rapidly in the positive direction, whilst the vanes were motionless. (7.) With a more perfect exhaustion still, at 0·098 millim. a sudden change was seen. The vanes which had been stationary then began to turn in the positive direction at a speed of 100 revolutions per minute, whilst the disks turned as before, positively, but with less speed. It is probable that the speed of this disk was diminished in consequence of the rapid movement of the vanes in the opposite direction.* (8.) When the exhaustion was carried beyond 0·098 millim. the speed of the two disks and of the vanes increased till it exceeded 600 revolutions per minute, and it did not seem to diminish with the highest rarefaction, which was at 0·0001 millim. According to the most recent determinations the number of molecules contained in a cubic centimetre of air at the ordinary pressure is probably something like 1,000,000,000,000,000,000,000 (one thousand trillions); consequently, at an exhaustion of 0·0001 millim., 100,000,000,000,000 are still left. This number is sufficiently large to justify the hypothesis—That when the molecules are set in vibration by a white-hot platinum wire they are still capable of exercising an enormous mechanical effect.

Researches on Accidental Double Refraction.—M. Macé.—The author finds that Wartheim's law is only applicable to ordinary glass compressed regularly or tempered.

New Direct-Vision Spectroscope.—M. Thollon.—The description of this instrument is not capable of abridgment. The author states that it is distinguished by its small bulk, its lightness, and by the ease and precision with which the prisms are handled. Its dispersive power can be rendered equivalent to that of 15 to 20 prisms of 60°. On applying it to the light of the sun he has seen over the whole outline of the disc the brilliant rays of hydrogen and helium with remarkable distinctness.

Densities of Vapour.—L. Troost.—The author finds that the vapour density of acetic acid resumes its theoretical value corresponding to 4 volumes, even at temperatures bordering upon 120° if we operate under feeble pressure. From this observation it results that the excess of the vapour density of acetic acid observed by M. Cahours when near its boiling-point may be explained by a rapid change of the coefficient of expansion of the vapour on the approach of its change of state. The density of the vapour of hyponitric acid likewise at temperatures close upon 22° takes its theoretical value corresponding to 4 vols. on operating under feeble pressure. On the contrary the analogous excess observed in case of sulphur seems explicable by a polymeric condensation of the molecules of the body, according to experiments made under feeble pressure at 360° and 440°.

Dissociation of Barium Carbonate.—M. Isambert.—Barytic carbonate is almost undecomposable by heat alone, though Abich has shown that it can be converted into caustic baryta at the temperature of a forge. If the carbonate is mixed with charcoal the decomposition is easier, a full red heat being sufficient to produce baryta and carbonic oxide. The charcoal maintains around the carbonate an atmospere in which the tension of the carbonic acid is constantly nil, and the decomposition, which only gives rise to a very slight tension of gas, can thus continue indefinitely. The author has verified this hypothesis by heating carbonate of baryta in a current of inert gas, and found decomposition ensue at a red heat.

Solubility of Lime in Water.—A. Lamy.—The solubility of pure lime in water may vary in a permanent or transitory manner with its nature or origin, its state of molecular aggregation, the temperature at which it has been prepared, its dehydration or recalcination at a red heat, the duration of its contact with water, and, lastly the previous heating of the lime-water more or less prolonged. The least soluble lime is that

* I have already explained, in a note laid before the Academy last year, that the friction of the air at an exhaustion of 0·098 millim. is only a little less than that which it shows at a normal pressure of 760 millims., and consequently the vanes, having a speed of 100 revolutions per minute, must exercise a considerable reaction on the contrary rotation of the disks.

prepared from a carbonate precipitated from the pure nitrate with carbonate of ammonia. The most soluble resulted from the calcination of limes of different kinds, the crystalline hydrate, marble, and the nitrate. Crystallised hydrate of lime dissolves only with excessive slowness at temperatures near that of melting ice. The numbers found at 0°, 54°, and at 100° differ very sensibly from those given by Dalton and Phillips.

Researches on the Nature of the Highly Volatile Products contained in Crude Benzines.—MM. C. Vincent and Delachanal.—Independently of the hydrocarbons already pointed out in that portion of the oils of coal which distils before benzin the authors have discovered and characterised common alcohol, cyanide of methyl, and sulphide of carbon. The two latter are in such proportions that it would be commercially advantageous to treat these light products, in order to manufacture acetate of soda and ammonia from the decomposition of the methyl cyanide and to extract the carbon bisulphide.

NOTES AND QUERIES.

Ancient Metallic Iron.—Can any of your readers refer me to any scientific work or paper in which I can find analyses of ancient metallic iron? I mean of well authenticated specimens belonging to the earliest epochs in which that metal was known.—A. E. A.

Safety Matches.—I have recently found by experiment that the "Special Safety Matches," which profess to *ignite only on the box*, will strike freely on common coal, provided of course both materials be dry. Anyone can verify this for himself, and the chemical reason is simple, viz., the combustible carbon of the coal takes the place of, and acts like, the amorphous phosphorus of the rubber. This fact, I think, will not only prove of general interest, but may also lead to the manufacture of a safety match without the employment of phosphorus, a result which, as observed by Hofmann, "would indeed be a grand achievement."—Bertram A. Muirhead, Lieut. R.N.

MEETINGS FOR THE WEEK.

Monday, 11th.—Medical, 8.30.
—— Royal Geographical, 8.30.
—— Society of Arts, 8. "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," T. Bolas, F.C.S.
—— London Institution, 5.
Tuesday 12th.—Civil Engineers, 8.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
—— Photographic, 8.
—— Anthropological, 8.
Wednesday, 13th.—Society of Arts, 8. "Further Remarks on Lightning Rods," Dr. R. J. Mann, F.R.A.S.
Thursday, 14th.—Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
—— Royal Society Club, 6.30.
Friday 15th.—Royal Institution, 8. Weekly Meeting. "The Explanation of Certain Acoustical Phenomena," Lord Rayleigh, F.R.S., 9.
—— Society of Arts, 8. (Indian Section). "The Colonisation of Hill Districts in India," Lieut.-General McMurdo, C.B.
Saturday, 16th.—Royal Institution, 3. "Gleanings from the Natural History of the Ancients," Rev. W. Houghton.
Physical, 3. "On the Transmission of Sound through Copper Wires," by Mr. Millar. "On Thermo-Electric Currents in Wires subjected to Mechanical Strain," by G. W. von Tunzelmann.

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THE CHEMICAL NEWS.

Vol. XXXVII. No. 955.

ON DYER'S CHEMICALS.

By J. MARZELL.

(Continued from p. 86.)

B. Phenol (Carbolic Acid), C_6H_5OH.

Manufacturing.

We owe the discovery of this body in coal-tar to Runge,* who, however, did not describe its constitution. Laurent† pointed it out to be a phenol-hydrate, and his works about it, as well as his method of producing it on a large scale, created the interest for that body, now produced in enormous quantities and in the state of utmost purity.

Runge treated the whole tar with milk of lime, diluted the formed carbolate of lime in water, filtered, and decomposed with a mineral acid. Afterwards, he distilled the crude carbolic acid, treated the distillate with basic acetate of lead, dried the precipitate, and got pure phenol by re-distilling the same.

Laurent, on the contrary, only took the oils distilling between 150° to 200° C. He treated that part of the "light oils" with a boiling soda solution, digested the basic oils from the precipitate, diluted the carbolate of soda in water, digested from the arising precipitate (basic oils, naphthalin, &c.), and decomposed the clear liquid with sulphuric acid. The oil is taken off, washed with water, dried with chloride of calcium, and then submitted to fractional distillation.

Laurent's acid—fusing at 34° C., and soluble in 33 parts of water—was a long time considered the pure phenol, and regarded as the standard body in the industry. In 1866 Crace-Calvert, however, succeeded—by an improved method—in producing a phenol, soluble in 20 parts of water, fusing at 41° C., and boiling at 182° C.

Laurent's acid, therefore, was impure, and really a body crystallising in large octahedra, and turning out to be carbolic acid + 1 aq. of water (in distilling it with caustic lime a phenol of 41° C. was obtained) could be isolated from an aqueous solution at +4° C.

Though the carbolic acid is heavier than water, only the oils below 1·00 sp. gr. are taken for its separation. Babœuf proposed the treatment of the creosote oils as well, but this process could not be naturalised in industry.

For the extraction of phenol, the "light oils" are taken either after having taken away the "crude naphtha" (up to 140° C.), or as they are received from the tar-still. The principle of separation rests upon the formation of a salt, and isolating the same from the neutral oils.

About the strength of the alkaline solutions to be taken opinions are various. Many manufacturers prefer to take a strong solution of caustic soda (25° to 30° B.), and to heat the oils up slightly with it by means of indirect steam, whilst others only use a solution of 15° to 20° T., and operate at ordinary temperature.

In the first case, iron tanks are taken of about 1000 galls. capacity (*e.g.*, adjusted to a crude naphtha still of about 800 galls. capacity), with a system of steam-pipes lying on the bottom. The oils are put in, warmed up (just lukewarm), and then the solution of NaOH is added, whilst well mixing, even by hand, or, better, by means of a mechanical arrangement.

To ascertain the needed quantity of NaOH, a sample of the respective oils (50 c.c.) are treated with a titrated solution of NaOH till a new addition of soda no longer diminishes the amount of neutral oils floating on the top. The proportions thus found, calculated back to the whole lot of light oils, will give the approximate quantity of soda to be taken.

The mass is allowed to cool down and to settle for some hours (it is best to let it stand over-night). After that the oils are swimming on the surface, whilst the carbolate, &c., of soda is to be found on the bottom as a pasty mass. The oils are drawn off, and have to undergo the usual treatment of distilling; whilst to the remaining mass 6 to 7 times its volume of water are added, and the whole heated up. The soda compounds of phenol and its homologues enter into solution, whilst the insoluble impurities separate, and are removed by digestion. The clear liquid is drawn into a lead-lined tank, and treated with sulphuric acid. The phenol and its homologues coming up to the top as an oil are drawn off into a second lead-lined vessel, and washed two or three times with cold water. This time the oil will settle to the bottom, because it was, indeed, lighter than the solution of sulphate of soda, but now is heavier than the water. The latter, therefore, has to be carried away by means of a syphon. Well mixing is a principal condition, as a quantity of water as small as possible has to be taken, because by the solubility of the carbolic acid a loss cannot be prevented. On the other side the washing has to be done as carefully as possible, because free H_2SO_4 would injure the iron stills. To prevent all losses these wash-waters are put aside and taken afterwards to dilute the caustic soda. The phenol obtained always contains water, which cannot entirely be separated by distilling, and which prevents the pure phenol from crystallising. It is therefore intimately mixed in a wooden tank with melted chloride of calcium, allowed to settle, and drawn off. Another way is to heat the phenol up by indirect steam, and to let pass through it a quick stream of dry air. The resulting dehydrated crude carbolic acid is submitted to fractional distillation. By preference small stills of 150 to 200 galls. capacity are taken, the thermometer plunging into the vapours. The stills are heated up generally with direct fire, but sometimes superheated steam is used. The coils are of lead.

As to the fractional points, they vary considerably. In many works, where the carbolic acid is only brought up to this point, that part above 1·00 sp. gr., and distilling between 176° to 204° C., is understood and sold as "crude carbolic acid." Everything coming over up to 176° C. is put to the light oils for re-distilling, and above 204° C. put to the creosote oils.

If the working up to a chemical pure product is intended the separation has to be closer to the boiling-point of the phenol, and only the part distilling between 186° to 195° C. generally is taken as suitable for the fractional distillation. The parts passing from 176° to 186° C. and from 195° to 204° C. are put aside and re-distilled several times, the quantities obtained here of fraction 186° to 195° C. being joined to the first product. The so-obtained distillate is put into suitable vessels, and submitted to a temperature of 8° to 10° C., which can easily be effected by letting circulate a fluid around the apparatus.

Following Lowe and Gill* (1874), it is best when the mixture of carbolic acid and homologues is capable, when dehydrated, of crystallising between 62° and 95° F. (16·5° to 35° C.). According to them it is better if the mass contains water, so that in a state of dehydration it is advisable to add water equivalent to a proportion of 5 to 30 per cent. About the temperature to cool it down to they recommend to vary between 15° to 50° F. (−9·5° to +10° C.), and propose to surround the crystallising vessels by cooling mixtures.

In these vessels the whole solidifies to a conglomerate of crystals impregnated with the liquid homologues. The crystals are separated in a centrifugal machine from the liquid, pressed, and submitted again to the distillation. Nearly all will pass over between 187° to 189° C. To effect a complete separation from the homologues the dis-

* *Poggendorff's Annalen*, xxxi., 65; xxxii., 328.
† *Ann. der Chem. et de Phys*, [3]. t. iii., p. 95.

* Patent, No. 1435.

tillate is submitted to another re-crystallisation, either by partial fusion or subsequent refrigeration of an aqueous solution by means of employing gradually changing temperatures. By another fractional distillation a pure phenol, answering all tests, will be obtained.

The apparatus used with advantage in the fractional distillation is the same as Girard and De Laire describe for isolating aniline from toluydin.* The refluxing condenser is filled with pure phenol, the vapours rising from the same being condensed in a coil especially for this purpose. The flue of the fire-place beneath the still goes around it, but an arrangement is made allowing to heat it up directly. Often paraffin, or any other heavy oil, is preferred to phenol, which, by its rapid evaporation, always wants much care, but in this case an iron pipe connects the condenser with the chimney to allow the vapours to escape. The still is filled with the mixture of phenol and homologues and heated up. The vapours rise into the refluxing condenser, but as this is cold, they are condensed and fall back into the still. To quicken the operation the refluxing condenser itself is heated up slowly, but the fire taken out as soon as the temperature is of about 170° to 175° C. By the vapours out of the still the bath is now heated up gradually to about 186° to 187° C., where the thermometer shows a constant point. Here the receiver must be changed. After a short time the thermometer begins to rise again, and another receiver is put on.

In the same way cresylol and even higher homologues can be obtained, only other fractions have to be taken to start with.

Emile Kopp† proposed to take for the decomposition of the carbolate of soda the acid and alkaline solutions having been used for the purifying of the first runnings. These liquids have to be mixed in such proportions as to produce a bisulphate of soda holding in solution the alkaloids which were united to the acid (aniline, toluydin, &c.). A heating up takes place, and the phenol separates as an oily mass on the top of the solution, consisting of sulphate of soda and the alkaloïds.

In the works the following process is adopted to recover the acid:—Directly from the mixing-tank the wash-acid is drawn into a lead-lined vessel, and there decomposed by water. A black disagreeably-smelling mass separates on the top, is taken off, and the remaining red weak acid taken for the decomposition of the carbolate of soda.

A method to get pure phenol was proposed by H. Müller.‡ The heavy oils are treated with milk of lime, the separated carbolate of lime diluted with water, filtered, and the liquid so obtained exposed to the oxidising influence of the air. A change of surface is hereby of great importance, and therefore the liquid is either filled into large flat vessels, or a stream of air is passed through it, or it is allowed to run in a fine stream between a system of vessels. When the liquid ceases to get darker it is filtered, and by an experiment in the laboratory the acid wanted for the decomposition is ascertained. Advantage is now taken of the difference in stability between the phenol and its homologues. If the acid is added in small quantities, and each time the precipitate separated by filtering, at the last portion of acid phenol is obtained in a state which allows to get a pure body (187° to 188° C.) after a few distillations. The phenol obtained in this way, however, gives an unpleasant smell, which (according to H. Müller) is due partially to sulpho derivatives. The addition of oxide of lead during the oxidation obviates that inconvenience.

Another way to effect this is the following:—The carbolic acid is treated at a temperature of 100° C. with a solution of oxide of lead in caustic soda, the mixture allowed to settle, and digested. After washing with sulphuric acid and digesting, a small quantity of H_2SO_4 is added, and a bichromate of potassium solution of a certain strength supplied gradually. When the oxidising process is finished it is digested, washed, and the remaining purified phenol rectified by distillation.

A. Ott* gives an account of carbolic acid manufacture (in America?), resting upon H. Müller's principles. But he only takes the oils distilling up to 212° C.

H. Schintzler describes† a process intending to get pure phenol by cokeing the impurities or making them insoluble.

Black, so-called carbolate of soda, is heated up in a copper still till the distillate gets milky (the heat is then not above 170° C. in the vapours). Then a quantity of three times its weight of water is added, the clear solution of carbolate of soda digested, and the phenol separated by decomposing with sulphuric acid.

The synthetical method of Wurtz, Kekulé, and Dusart,‡ adjusted to industrious conditions, allows to produce a pure phenol directly from benzol by baking the soda-salt of the benzo-mono-sulpho-acid with caustic soda. To manufacture the benzol-mono-sulpho-acid ($C_6H_5SO_3H$) equal parts of oleum and benzol are mixed at common temperature. Common H_2SO_4, of 1·840 sp. gr., can also be used with advantage, but in this case a slight heat has to be supplied. If all benzol is diluted, three to four times its weight of water is added, digested, and the aqueous solution of sulpho-acid and free sulphuric acid precipitated with caustic lime. The separating $CaSO_4$ is taken away by filtering and the hot solution treated with carbonate of soda till a sample does not show any more precipitate on the addition of a new quantity. The solution of $C_6H_5SO_3Na$ so obtained is evaporated down to a certain concentration, and baked with caustic soda.

According to Ch. Girard (Würtz) pressure-tubes with agitators are very convenient for the soda melt. The best horizontal cylinders are taken, provided with pressure gauge, safety-valve, steam-pipe, man-hole, a pipe for blowing out the melt if finished, a pipe for the thermometer, and two or three cocks at different heights for taking out samples during the operation. The man-hole has not to shut till the reaction begins. Then the fire is moderated, and the agitator put in movement. In this way the formation of secondary products can be prevented partially. The melt is diluted with water in lead-lined tanks, and decomposed with H_2SO_4. The resulting phenol is extracted with ether, digested, the ether evaporated away, and the resulting phenol purified by re-distillation.

Church|| obtained a very pure carbolic acid in diluting about 1lb. of white crystalline phenol in 20 lbs. of cold water, but with the precaution that not all the phenol goes into solution. The liquid is saturated with NaCl, and the phenol got as a yellow oil on the top. In distilling it with caustic lime the resulting anhydrated phenol can be got crystallised.

Examinations.

To examine for carbolic acid a great number of methods have been indicated. An aqueous solution of iron perchloride causes a blue colouring, the more intense the purer the phenol. Also with chloride of lime and ammonia a blue colouring is obtained.

Plugge recommends NO_2 as a very sensitive reagent. Even traces of it colour red with phenol. (Larger quantities of NO_2, however, render the reaction indistinct.) Nitrate of mercury, containing free NO_2, can be taken in preference.

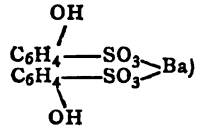
Landolt treats a solution of phenol with bromine-water. The yellowish white precipitate of tribrom-phenol is separated by filtering, and treated by amalgam of sodium, $+H_2O$, and warming up slightly. On addition of sulphuric acid the phenol is separated therefrom as oil.

Schödler proposes to use the formation of mono-phenol-sulpho-acid. 2 or 3 gr. of the respective body are heated upon a water-bath, and the same quantity of sulphuric

* Derivs. de l'Houille, Paris, 1872.
† *Moniteur Scientifique*, 1860, pp. 823, 824. *Zeit. für Analyt. Chem.*, 1865, p. 270.

* *Dingler's Poly. Journ.*, clxxxvii., 946.
† *Ibid.*, ccxiv., 86.
‡ *Bull. de la Soc. Chim.*, viii., 198. Chem. News, No. 620, p. 173.

acid is added gradually. After some time standing at a temperature of 50° to 60° the solution is saturated with $BaCO_3$, filtered, and the filtrate (containing the Ba salt of the phenol-mono-sulpho-acid,—



decomposed with sulphuric acid. The precipitate of $BaSO_4$ is dried, weighed, and calculated back for phenol.

E. Pollacci* has published very interesting researches about the sensibility of some reagents.

Blue colouring with $NH_3+CaOCl_3$	1-3000th part.
Violet, with Fe_2Cl_6	1-2000th ,,
Yellow, with hot NO_3H	1-6000th ,,
Yellow precipitate with Br water ..	1-15500th ,,

For examining crude carbolic acid two methods are used in commerce:—

(1.) To see how much tar-acids—phenol and homologues—there are in a given sample:—Into a graduated cylinder of 100 c.c. 50 c.c. of the mixture are put, and—whilst shaking well at each fresh addition—a solution of caustic soda is applied gradually. In allowing the mixture to settle, the neutral oils gather on the surface, and if a new quantity of soda solution does not diminish them any more it is easy to see how much indifferent oil there is present.

(2.) To fix the crystallising-point of a dehydrated sample:—1000 grs. of the fluid are put into a glass retort and distilled. If 100 c.c. are gone over—only phenol, not water and phenol together—the receiver is changed, and the next 62 per cent, = 620 grs., collected. A crystal of phenol is added, and whilst stirring well with a glass rod or the thermometer, notice is taken of the temperature at which the mass solidifies. This crystallising-point, compared with that of standard products, will give a certain point of examination of the quantity of the sample.

(To be continued).

TESTS OF THE SERVICE OF A DOMESTIC WATER-FILTER.

Communicated by Prof. ALBERT B. PRESCOTT.

To obtain some data as to the efficiency of the filtration of rain and river water, by the portable filters used for household purposes in many parts of the United States, it was proposed to make comparative determinations of waters before and after filtering. The results obtained so far, and here given, are from the work of Messrs. E. M. Reed and Theo. Hauck, done under my direction.

Only the following determinations have been made: (1) The "free ammonia" and "albuminoid ammonia" of the Wanklyn process; (2) the chlorine; and (3) the total residue at 100° C., and again after ignition. The time at disposal was not enough for determinations of the organic carbon and nitrogen in the residue by Frankland's process. In any view of Wanklyn's determinations, their application to a given water, before and after a given operation upon it, must give good data as to the effects of such operation on the nitrogenous organic matter. As a measure of the removal of inorganic solids, the residue by ignition was the chief reliance, though the residue constant at 100° C. was weighed. The loss by ignition is presented as a factor to inquire about. It is well enough known that loss by ignition bears no regular ratio to quantity of organic matter. The chlorine was determined, as evidence of the character of the organic matter, and to see what effect the filter had upon diffusible salts.

The filters used were of a kind in common use for filtering rain-water for potable purposes; the bed being pulverised wood-charcoal with layers of gravel. For Nos. 3 and 5 to 10, a new filter was taken. The bed of this was about 28 inches in depth, and 18 inches in diameter at the top, narrowing a little at the bottom. At the top was a three-inch layer of pebbles, then an eighteen-inch layer of charcoal, mixed with pebbles, then an inch of pebbles, and last, about six inches depth of charcoal, retained at the orifice of the reservoir by wire-cloth. All the charcoal was hard-wood charcoal, "pulverised right to let the water through," the manufacturer said. For No. 1, a smaller filter of the same pattern was used, and after being in daily use about eight months, the filter bed not being filled with water (or excluded from the air) more than one-third of the time. The filter used for No. 2 had been long in service, but had been covered with water only a small portion of the time. For No. 4, the filter used had been in employ two or three months, and constantly covered with water during this time. The water entered the bed at the bottom, and was drawn off at the top.

No. 1 was rain-water from a cistern; No. 2, well-water; No. 3, water from a spring coming out in a cemetery; No. 4, rain-water, it is not known how collected; Nos. 5 to 9, inclusive, rain-water contaminated with urine; No. 10, distilled water, contaminated in the same way.

The samples, No. 3 and 5 to 10 inclusive, were filtered through the new filter (first above described), consecutively in the order of their numbers, with intervals of a few days (and exposure to air) between the filtrations.

Parts of "Free Ammonia" in One Million Parts of Water.

Waters.	Before Filtering.	After Filtering.	Removed by Filtering.
No. 1.	0·50	0·070	0·430 or 86 per cent.
,, 2.	0·08	0·020	0·060 ,, 75 ,,
,, 3.	0·05	0·008	0·042 ,, 84 ,,
,, 4.	1·34	0·140	1·200 ,, 89 ,,
,, 5.	33·00	8·100	24·900 ,, 75 ,,
,, 6.	4·00	0·400	3·600 ,, 90 ,,
,, 7.	2·50	0·080	2·420 ,, 96 ,,
,, 8.	4·06	0·620	3·440 ,, 84 ,,
,, 9.	1·94	0·420	1·520 ,, 78 ,,
,, 10.	1·08	0 180	0·900 ,, 83 ,,
Mean			3·85 or 84 ,,

Parts of "Albuminoid Ammonia" in One Million Parts of Water.

Waters.	Before Filtering.	After Filtering.	Removed by Filtering.
No. 1.	0·30	0·01	0·29 or 96 per cent.
,, 2.	0·14	0·06	0·08 ,, 57 ,,
,, 3.	0·07	0·07	0·00 ,, 0 ,,
,, 4.	1·14	0·57	0·57 ,, 50 ,,
,, 5.	1·90	0·10	1·80 ,, 94 ,,
,, 6.	0·40	0·10	0·30 ,, 75 ,,
,, 7.	0·50	0·03	0·47 ,, 94 ,,
,, 8.	0·38	0·06	0·32 ,, 84 ,,
,, 9.	0·30	0·04	0·26 ,, 86 ,,
,, 10.	0·06	0·01	0·05 ,, 83 ,,
Mean	.. ..		0·41 ,, 72 ,,

Grains of Total Residue left at 100° C. from One Gallon of Water.

Waters.	Before Filtering.	After Filtering.	Removed by Filtering.
No. 1.	24·556	11·265	13·259 or 54 p. ct.
,, 2.	119·274	102·343	16·931 ,, 14 ,,
,, 3.	82·432	81·876	0·556 ,, $\frac{6}{10}$,,
,, 4.	35·084	30·243	4·841 ,, 13 ,,
,, 5.	222·723	197·226	25·497 ,, 11 ,,
,, 6.	199·952	156·107	43·845 ,, 21 ,,
,, 7.	197·693	141·826	55·867 ,, 28 ,,
,, 8.	181·273	150·194	31·079 ,, 17 ,,
,, 9.	110·963	97·852	13·111 ,, 12 ,,
,, 10.	102·837	89·651	13·186 ,, 13 ,,
Mean			21·817 ,, 18 ,,

Gaz. Chim. Italiana, vi., p. 8.

Grain of Residue after Ignition from One Gallon of Water.

Waters.	Before Filtering.	After Filtering.	Removed by Filtering.
No. 1.	10·526	10·101	0·425 or 4 p. ct.
,, 2.	87·362	85·141	2·221 ,, 2 ,,
,, 3.	33·322	31·926	1·396 ,, 4 ,,
,, 4.	3·508	2·836	0·672 ,, 19 ,,
,, 5.	106·997	76·385	30·612 ,, 29 ,,
,, 6.	73·662	70·263	3·399 ,, 4 ,,
,, 7.	86·915	83·715	3·200 ,, 3 ,,
,, 8.	63·781	59·624	4·157 ,, 6 ,,
,, 9.	64·876	41·937	22·939 ,, 35 ,,
,, 10.	71·139	55·851	15·288 ,, 21 ,,
Mean			8·431 or 13 ,,

Grains of Loss by Ignition of Residue from One Gallon of Water.

Waters.	Before Filtering.	After Filtering.	Difference Due to Filtering.
No. 1.	14·030	1·164	12·866 or 91 p.c. less.
,, 2.	31·912	17·202	14·710 ,, 46 ,, ,,
,, 3.	49·110	49·950	0·840 ,, 2 ,, more.
,, 4.	31·576	27·407	4·169 ,, 13 ,, less.
,, 5.	115·726	120·841	5·115 ,, 4 ,, more.
,, 6.	126·290	85·844	40·446 ,, 32 ,, less.
,, 7.	110·788	58·111	52·677 ,, 47 ,, ,,
,, 8.	117·492	90·570	26·922 ,, 23 ,, ,,
,, 9.	46·087	55·915	9·828 ,, 21 ,, more.
,, 10.	31·698	33·800	2·102 ,, 6 ,, ,,
Mean			13·390 ,, 22 ,, less.

Grains of Chlorine in the Chlorides of One Gallon of Water.

Waters.	Before Filtering.	After Filtering.	Removed by Filtration.
No. 1.	None	None	
,, 2.	6·626	6·393	0·233 or 3 per cent.
,, 3.	1·933	1·532	0·401 ,, 21 ,,
,, 4.	None	None	
,, 5.	Trace	,,	
,, 6.	,,	,,	
,, 7.	,,	,,	
,, 8.	,,	,,	
,, 9.	,,	,,	
,, 10.	,,	,,	

The results show that an average of 72 per cent. of the putrescible matter indexed as albuminoid ammonia by the Wanklyn process was removed by filtration. The instance of least removal was the 50 per cent. of No. 4, with use of a filter which had been continuously covered with water, and was doubtless saturated in part with the organic solids. On the other hand, the small filter taken for No. 1, which had been in daily use for eight months, but had been drained off and left to the air for the larger part of the time every day, removed 96 per cent. With Nos. 2 and 3, the quantity found present before filtering was so small that the result of filtration is not conclusive.

The removal of "free ammonia" seems to have averaged 12 per cent. larger, and to have been much more uniform than that of "albuminoid ammonia." The steady removal of so large a proportion of ammonium compounds, by charcoal filters doing daily service for months, is a result of much interest. It is desirable to have farther investigation as to this removal, and especially as to the appearance of nitric acid, from oxidation. It is to be noted that the submerged filter used for No. 4 did not fail to remove ammonia, if the single determination can be relied upon. The evidence is too narrow to prove, as it implies, that dissolved oxygen suffices to oxidise ammonium salts, while atmospheric oxygen is required to oxidise the organic matter yielding ammonia with the permanganate, alkali, and heat, of Wanklyn's process.

The meaning of the results of the determinations of total residue after ignition is not obvious. The quantities of this residue from rain-waters are so large that one is forced to consider the extraction of inorganic salts from the filter-bed. The effect of filtration upon the ignition-loss (the water of hydration and carbon dioxide and organic matter of the residue) seems to vary between 91 per cent. taken away, and 21 per cent. added by the filtration.

University of Michigan,
September 26, 1877.

THE APPLICATION OF SONSTADT'S SOLUTION TO THE SEPARATION OF MINERALS FOR CHEMICAL ANALYSIS.

By EDWARD T. HARDMAN, F.C.S.
Geological Survey of Ireland.

I SEND the following account of what is perhaps the first application of the above liquid to such a purpose.

Professor A. H. Church, in a short article in the *English Mechanic* (vol. xxvi., p. 327), has noted the applicability of Sonstadt's solution to the separation of minerals, but so far as I gather from that paper, it does not appear to have been practically used for analytical purposes. The liquid consists of a solution of iodide of mercury, in iodide of potassium, and is made by adding alternately those salts in a dry state to the solution, until no more of either is dissolved. The free iodine which sometimes colours it is then removed by means of a crystal or two of hydrosulphite of sodium, and the liquid, which possesses a very high density, then presents a light straw colour. Professor Church has obtained it of a density of 3·01, so that a very large number of minerals could be separated, and their density determined directly, by using various strengths of the liquid from the above downwards.

At the time I noticed Mr. Church's article, I had a very difficult problem to solve as to the separation of minerals. A basalt from the North of Ireland contained a peculiar mineral in great abundance, which I had every reason to believe an undescribed one. I wished to get sufficient of it for analysis, but though disseminated throughout the rock in great profuseness as small nodules, it proved a most tedious task to attempt to collect a quantity of it—in fact, after about three weeks hard work with a forceps I only succeeded in obtaining sufficient for a qualitative analysis. As in the course of this it was ascertained that the mineral is of a low specific gravity, it occurred to me that it might be separated by a liquid of high density, and while I was trying for such a liquid Professor Church's note caught my attention. The liquid he recommends succeeded admirably. That which I used had a specific gravity of only 2·40, which was more than sufficient for my purpose, as the specific gravity of the mineral in question subsequently proved to be only 1·70. The method of separation I adopted was somewhat different to that proposed by Prof. Church. The basalt was roughly crushed, and then turned into a sieve. As the mineral is very brittle, a great quantity of it came through mixed with the finer particles of the basalt. It was again sifted so as to get rid of the small dust, and then thrown in small quantities at a time into a small porcelain basin containing Sonstadt's solution, and well stirred with a glass rod, to ensure that the heavier minerals were wetted with the solution, as otherwise they sometimes float on it. The unknown mineral then collected in a black scum on the surface, and was skimmed off with a feather, immediately deposited in a beaker of distilled water, and well washed to remove any traces of the solution. On contact with water, however, a little red iodide of mercury is precipitated, which can be redissolved, and washed away by a little iodide of potassium, so that there is no danger of a mineral so collected being contaminated by a trace of mercury.

As soon as a sufficiency of the mineral had been collected thus it was purified by being again floated on the liquid. A small quantity of other minerals (augite, felspar, &c.), which had been caught up in the first floatation—if I may use the word—sank to the bottom, and the unknown mineral was again collected and washed. By this process I succeeded in obtaining about 2 grammes of the mineral for analysis,* an amount which I doubt if I should had extracted after months of hard labour by any other method, and if I had the time and patience necessary to be devoted to the task.

Of course, there are many minerals which would be attacked by this solution, but a great number would be unaffected by it, for the short time they would be in contact with it most of the silicates would be utterly untouched by it, and a great number of separations might be effected. For instance, it would be possible to separate completely the three constituent minerals of granite—mica, felspar, and quartz—weigh them and determine absolutely their percentage, a matter which has yet only been determined by mathematical calculations, based on assumption which can be at least only approximately correct.

14, Hume Street, Dublin, March 4, 1878.

ON A

NEW METHOD OF WEIGHING PRECIPITATES.

By ARTHUR W. CLARK.

ONE of the most frequent mechanical operations that has to be carried out in the chemical laboratory is the drying of precipitates prior to weighing them. This manipulation is always tedious, and in some cases involves a considerable expenditure of time and patience, for it is evident that unless the precipitate is thoroughly dried the apparent weight will not be the real weight.

Arsenate of magnesia and ammonia is a precipitate which has to be most carefully dried, since at a temperature very little above 212° F. it is decomposed.

I shall endeavour to show in this paper how a precipitate can be weighed by merely washing it into an ordinary specific gravity flask from the filter, and then calculating the real weight from the weight of the flask completely with water and the precipitate.

The ordinary sp. gr. flask contains 1000 grains of pure water at a normal temperature. Now if we suppose such a flask to be filled with a substance whose specific gravity call a, it is obvious that the whole would weigh 1000 a grs. (*plus* the weight of the flask). For instance, the sp. gr. of lead is about 10, which means that bulk for bulk lead is 10 times heavier than water. Suppose the flask to be completely filled with metallic lead, then the whole would weigh 10 × 1000 grains. Now let us suppose it to be only half filled with the substance, then the whole would weigh in grains $\frac{1}{2}$ 1000 a + $\frac{1}{2}$ 1000. And so generally if the substance occupies $\frac{1}{x}$ th of the volume of the flask the whole will weigh in grains :—

$$\frac{1}{x} = 1000\,a + \frac{x-1}{x}\ 1000.$$

Calling the weight w, and solving the equation, we get—

$$\frac{1}{x} = \frac{w-1000}{1000\,(a-1)}$$

But since the whole volume (that is, the flask completely filled) would weigh 1000 a, the $\frac{1}{x}$-th of the whole must weigh—

$$\frac{1}{x}\ 1000\,a.$$

Substituting the above value for $\frac{1}{x}$ in this expression we get—

$$\frac{w-1000}{1000(a-1)} \times 1000\,a$$

or—

$$\frac{(w-1000)\,a}{a-1},$$

which is the formula for calculating the real weight of the substance in the flask, w being the gross weight less the weight of the flask, and a being the specific gravity of the substance. In this formula it is obvious that $w-1000$ is the expression for the increase in weight of the flask between the two weighings, *i.e.*, the weight when full of pure water and the weight when full of the substance and the pure water. Call this increase C, and the formula becomes—

$$\frac{C\,a}{a-1}$$

The following is an example of the utility of this method of weighing precipitates :—The specific gravity of the precipitate called arsenate of magnesia and ammonia is, prior to drying, about 3. A sample to be assayed for arsenic was treated in the usual way, and the precipitate collected on a filter and washed; it was then washed into a specific gravity flask capable of holding 4600·35 grains of water at the normal temperature. The whole was then found to weigh 4660·47 grains, so in this case C = 60·12, and a = 3, therefore formula becomes—

$$\frac{60{\cdot}12 \times 3}{3-1}.$$

or—

$$\frac{180{\cdot}36}{2},$$

that is 90·18; therefore real weight of the precipitate was 90·18 grains.

I have used this method of weighing for four months, and am satisfied that the process is accurate and speedy, but of course great care must be taken in handling the flask, &c., so that the temperature may not be influenced by the heat of the hands, &c.

* This analysis will be shortly submitted to the Royal Irish Academy.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 7, 1878.

Dr. GILBERT, Vice-President, in the Chair.

AFTER the confirmation of the minutes of the preceding meeting, the following certificates were read for the first time :—G. H. Rutter, R. H. Jude, A. K. Huntington, K. H. C. Nevile. The name of Mr. M. Zingler, whose certificate was read for the first time on February 7, was accidentally omitted from the report of that date. The list of the Officers proposed for election on March 30 was read from the Chair. The names of the gentlemen retiring, &c., were given in the report of the last meeting, with one exception, that Mr. C. E. Groves retires from the Council instead of Prof. R. V. Tuson. It was also announced that Mr. Hall was prepared to receive subscriptions (of 10s.) from Fellows for the next volume of the *Proceedings of the Royal Society*.

The CHAIRMAN then called on Mr. PERKIN to read his paper, "*On some New Derivatives of Anisoil.*" Dry precipitated methyl-orthoxy-phenyl-acrylic acid is placed in contact with hydriodic acid (sp. gr. 1·94) for two or three days, the mixture being frequently agitated. The resulting product, drained by a filter-pump, and then added in small quantities to a cold saturated solution of sodium carbonate, great care being taken to prevent any rise in

temperature. The milky fluid thus obtained is distilled. Ortho-vinyl-anisoil separates from the distillate as an oily layer; it has the formula—

$$C_6H_4 \begin{cases} (OCH_3)^o \\ CH=CH_2 \end{cases}$$

It polymerises so quickly as to prevent the correct determination of its boiling-point, which is about 195° to 200° C. Heated for an hour to 150° it solidifies to a transparent glass-like substance. The odour of ortho-vinyl-anisoil differs from that of its isomer, para-vinyl-anisoil, and resembles coal-tar naphtha (sp. gr. at 15° 1·0095, at 30° 1·000). By a similar process, substituting, however, hydrobromic acid, ortho-allyl-anisoil was obtained, boiling without polymerising at 222° to 223° C. It is a highly refracting liquid, with sp. gr. at 15° 0·9972. Similarly, with hydriodic acid, ortho-butenyl-anisoil was obtained, boiling at 232° to 234°; sp. gr. at 15° 0·9817. In a previous paper the author endeavoured, without success, to prepare para-vinyl-anisoil from methyl-paroxy-phenyl-acrylic acid by treating with hydrobromic acid, &c. By substituting hydriodic acid he has obtained this substance, resembling in its properties the body prepared by distilling methyl-paroxy-phenyl-acrylic acid: its fusing-point was, however, +3° instead of −1°; sp. gr. at 15° 1·002. In conclusion, the author compares the ortho and para compounds as regards their physical properties:—

(1.) *Boiling-points.*

Para-vinyl-anisoil boils at ..	204° to 205°
Ortho-vinyl-anisoil boils at ..	uncertain
Para-allyl-anisoil boils at ..	232
Ortho-allyl-anisoil boils at ..	222 to 223
Para-butenyl-anisoil boils at..	242 to 245
Ortho-butylen-anisoil boils at..	232 to 234

(2.) *Specific Gravity.*

	15° C.	30° C.
Para-vinyl-anisoil ..	1·0029	0·9956
Ortho-vinyl-anisoil ..	1·0095	1·0000
Para-allyl-anisoil ..	—	0·9852
Ortho-allyl-anisoil ..	0·9972	0·9884
Para-butenyl-anisoil ..	—	0·9773
Ortho-butenyl-anisoil	—	0·9740

The ortho compounds refuse to crystallise even when placed in a freezing mixture; the para bodies crystallise freely. *α*-methyl-orthoxy-phenyl-acrylic acid from coumarin, treated with hydriodic acid, and then with an alkaline carbonate, yields an oil which is apparently identical with the ortho-vinyl-anisoil prepared from the *β*-acid. The author is engaged in the investigation of this acid.

The next paper was also by Mr. PERKIN, and was entitled "*Note on the Action of Ammonia on Anthrapurpurin.*" In a previous paper the author mentioned that an ammoniacal solution of anthrapurpurin changes to an indigo-blue colour when heated in a sealed tube to 100° C. Hydrochloric acid throws down from this solution a dark purple precipitate, re-dissolving in ammonia to a blue solution. This substance dyes alumina mordants a purple, and weak iron mordants an indigo-blue colour. On examining this substance it proves to be unstable, easily resolvable into anthrapurpurin. If the solution above mentioned be heated in a sealed tube to 160° to 180° instead of 100° a purple solution results. On acidifying with hydrochloric acid a chocolate-coloured precipitate forms. This, when boiled with barium hydrate (after washing) dissolves to a purple solution: on acidifying a precipitate is formed. This, after washing and drying, is dissolved in alcohol. On concentration the dark red solution yields dark greenish or black crusts. This substance the author proposes to call anthrapurpuramide or amido-alizarin. It has the formula $C_{14}H_9NO_4$. It does not dye mordants. By the action of nitrous acid iso-anthraflavic acid was obtained.

After some remarks by Dr. Witt and Dr. Armstrong, the thanks of the Society were given to Mr. Perkin for his communications, and the CHAIRMAN called on Mr. G. S. JOHNSON to read a paper "*On certain Poly-iodides.*" In December, 1876, the author described the compound RI_3. As the mercury compound, HgI_6, is well known, it seemed probable that the true formula might be R_2I_6, and if so, that substitution-compounds might be obtained by displacing one atom of potassium by one atom of some other monatomic element. Silver was the element first tried. $AgR_3I_{12}RI+5H_2O$ was, however, the only salt the author succeeded in isolating. It is efflorescent over strong sulphuric acid, but deliquesces in air. It can be re-crystallised by dissolving in a small quantity of water and evaporation over sulphuric acid. The crystals present a stepped arrangement, are almost black, with a peculiar lustre. An excess of water decomposes the salt. The author next endeavoured to prepare the compound R_2TlI_{12}, but without success, the only compound obtained being that discovered by Willm, $xTlI_3.RI+2H_2O$. Before the isolation of potassium tri-iodide, Biffard supposed that the solution of iodine in aqueous potassium iodide contained a definite periodide, because it gave a dark coloured precipitate with a solution of acetate of lead. By using alcohol as a solvent instead of water the author obtained a crystallised compound (a specimen of which was exhibited), not deliquescent, crystallising in square prisms. By gradual evaporation fairly large crystals were obtained, with six faces, two having a dark purple, four a greenish golden reflection. The compound can be re-crystallised from hot alcohol; sp. gr. 3·084. Analyses of the constituents led to the complicated formula $Pb_8C_{36}H_{54}O_{28}K_6I_{17}$. The author has not yet been able to suggest a rational formula.

The next paper was "*On an Improved Form of Wash-Bottle,*" by T. BAYLEY. To prevent the reflux of steam or other gases—such as ammonia, &c.—into the mouth of the operator, the author suggests the following modification of the ordinary wash-bottle:—The mouthpiece is provided inside the bottle with a Bunsen valve—*i.e.*, a piece of india-rubber tube with a slit—a third tube is inserted in the cork, having two T-tubes outside the bottle: the ends of these T's are connected by a piece of caoutchouc tube which can be closed by pressure. The orifice of this third tube between the two T's is closed by a small cork. The only connection, therefore, passing outwards, between the inside of the bottle and the atmosphere, except by the washing-jet, is through the india-rubber tube connecting the two T's. The operator blows in through the Bunsen valve, closing the said india-rubber tube by pressure. As soon as he ceases blowing the valve shuts, and prevents any reflux; whilst he can, by taking off his finger from the india-rubber tube, stop the action of the washing-jet, or by keeping the pressure on continue the action for nearly a minute. This third tube also serves to pour out water when the bottle is reversed. A sketch of the arrangement accompanies the paper.

The last paper was "*On the Preparation of Glycollic Acid,*" by R. T. PLIMPTON. The author made two attempts to prepare calcium glycollate by following the directions of Prof. Church (*Journ. Chem. Soc.*, series ii., vol. i.). 2 lbs. of granulated zinc and 2 ozs. of oxalic acid were used in each operation. Some needles resembling calcium glycollate were obtained, but the quantity was too small for analysis.

The Society then adjourned to March 21, when a paper on "Aromatic Nitrosamines," by Dr. Otto Witt, will be read.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 19, 1877.

E. W. BINNEY, F.R.S., F.G.S, President, in the Chair.

"*Note on a Method for Determining the Coefficients in Chemical Equations,*" by JAMES BOTTOMLEY, D.Sc.

When two or more chemical compounds act upon one another so as to produce new compounds, provided we

know the composition of each, the result may be expressed by a chemical equation. Sometimes, in drawing out the equation, we have some trouble to determine the coefficients to be used with the compounds on each side.

As far as I am aware, the methods used are purely tentative. It occurred to me that in cases where the composition of all the products is known, we might apply the method of indeterminate coefficients as follows:—Let S be the symbol of an element and a_1, b_1, &c., the number of atoms of that element occurring in the various compounds entering into the equation.

S_2 and a_2 b_2, &c., have the same meanings with reference to another element. The letters a_1b_1, a_2b_2, &c., may have any positive integral value including O. Then a chemical compound may be denoted by S_1a_1, S_2a_2, &c., which for brevity may be denoted by A. So B will denote a compound of the form S_1b_1, S_2b_2, &c., and so on for other compounds. Hence the chemical equation may be written in the form—

$$P_1A+P_2B+\&c.=Q_1M+Q_2N+\&c. \quad \ldots\ldots \quad (1)$$

P_1, P_2, Q_1, Q_2, &c., being undetermined. Then, equating the terms containing S_1S_2, &c., we have equations of the form—

$$S_1(P_1a_1+P_2b_1+\&c.)=S_1(Q_1m_1+Q_2N_1+\&c.$$
$$S_2(P_1a_2+P_2b_2+\&c.)=S_2(Q_1m_2+Q_2n_2+\&c.)$$
$$\ldots\ldots\ldots\ldots\ldots\ldots=\ldots\ldots\ldots\ldots\ldots\ldots$$
$$Sn(P_1a_n+P_2b_n+\&c.)=Sn(Q_1m_n+Q_2n_n+\&c.$$

From the above equations the letters S_1, S_2, &c., might have been omitted, but are retained to show that there will be as many equations as elements. Hence if the number of elements be equal to the number of compounds we shall have sufficient equations to determine P_1, P_2, Q_1, Q_2, &c. If the number of compounds exceed the number of elements by unity, take any one of the undetermined coefficients, then all the rest may be determined as multiples of that one, and replacing these values in equation (1), both sides will be multipled by the same arbitrary quantity, which may therefore be omitted.

Within the last few years chemical compounds of considerable complexity have been obtained, and for their quantitative reactions such a method as that suggested might be serviceable. Annexed are two examples of the method applied to well known chemical equations.

(1.) Copper and nitric acid yield water, copper nitrate, and nitric oxide—

$$P_1Cu+P_2(HNO_2)=Q_1(H_2O)+Q_2[Cu(NO_3)_2]+Q_3(N_2O_2).$$

Hence we have the system of equation—

$$P_1=Q_2, P_2=2Q_1, P_2=2Q_2+2Q_3, 3P_2=Q_1+6Q_2+2Q_3.$$

Hence we get $P_2=\frac{1}{2}P_1$, $Q_1=\frac{1}{2}P_1$, $Q_2=P_1$, $Q_3=\frac{P_1}{3}$ substituting in the equation and multiplying each side by $\frac{3}{P_1}$ we get the usual equation—

$$3Cu+8HNO_3=4H_2O+3Cu(NO_3)_2+N_2O_2.$$

II. Potassium ferrocyanide, water, and sulphuric acid yield ferrous sulphate, ammonium sulphate, potassium sulphate, and carbonic oxide—

$$P_1(C_6N_6K_4Fe)+P_2(H_2O)+P_3(H_2SO_4)=$$
$$=Q_1(CO)+Q_2(FeSO_4)+Q_3(NH_4)_2SO_4+Q_4(K_2SO_4).$$

Here the group SO_4 may be treated as an element. From the above equation we get the subsidiary equations—

$$6P_1=Q_1, 6P_1=2Q_3, 4P_1=2Q_4, P_1=Q_2, 2P_2+2P_3=8Q_3, P_3=Q_2+Q_3+Q_4.$$

Hence we get—

$$Q_1=6P_1, Q_2=P_1, Q_3=3P_1, Q_4=2P_1, P_2=6P_1, P_3=6P_1.$$

Replacing these values in the equation and dividing both sides by P_1 we get—

$$C_6N_6K_4Fe+6H_2O+6H_2SO_4=$$
$$6CO+FeSO_4+3(NH_4)_2SO_4+2(K_2SO_4),$$

which is the equation given by Fownes.

CORRESPONDENCE.

AMMONIA IN FILTERED WATER.

To the Editor of the Chemical News.

SIR,—Professor Bischoff has read the sentence (paragraph 2) in my letter (CHEMICAL NEWS, vol. xxxvii., p. 38) in a different light to that which I intended when writing it. It was my intention to have conveyed the meaning that it is to the reducing influences (not influence as misquoted) of sulphuretted hydrogen and iron existing as ferrous compounds in the London clay, Greensands (and carboniferous) formations, that the presence of ammonia and the small quantity of nitrates (generally nil) is due,—that a resemblance is met with in the case of waters passed over spongy iron (*vide* exception at close of paragraph 5) also due to reducing influences, and that the ammonia resulting from such processes should not be confounded with the ammonia formed as a first product of the decomposition of animal organic matter. The whole sentence was an answer to paragraph 1, and these two paragraphs stand distinct from the remainder of the letter.

On the cause of the formation of ammonia the compilers of the Sixth Report of the Rivers Pollution Commission themselves are reticent in passing a decided opinion; this is instanced from the following extract, page 98. "The greensands contain, almost invariably, protoxide of iron, which probably exercises a reducing effect upon the nitrates and nitrites present in the water, removing their oxygen and transforming a portion of their nitrogen into ammonia, whilst the remaining nitrogen escapes as gas. In some cases even the sulphates present in the water are attacked and reduced, and sulphuretted hydrogen generated. The evidence of previous animal contamination is thus diminished or even obliterated altogether, whilst the water acquires a considerable proportion of ammonia." While I do not assert that the ammonia in water from the above mentioned strata is due to the combination of atmospheric nitrogen with hydrogen, I should be sorry, judging from analogies, to contradict a statement that a part may have been so caused. Regarding the discepancies in the amounts of ammonia:—In the Rivers Pollution Commission experiments the water was not submitted to spongy iron alone: after filtration it was exposed to the air in the form of a fine jet; this is necessary to peroxidise the first formed oxide of iron; a filtration through sand then ensued, to effect the removal of the ferric hydrate. Is not this accompanied by a removal of some of the ammonia? The fineness of the jet and the rate of sand filtration probably constitute important factors, especially as the sand is not covered with water.

In my experiments, as I have already mentioned, the oxidation to and removal of ferric hydrate was not attempted. In other words, in the Rivers Pollution Commission experiments, the water was submitted to both reducing and oxidising filtering media, in my experiments to the reducing medium alone. I have given an analysis, entitled "Bad water." This I selected as an instance on account of the abnormal amount of ammonia obtained.

Comparative filtration (as regards speed) of like samples of water shows that with an oxidising filtering medium the organic carbon is largely removed, with a reducing medium the organic introgen is removed in a relatively greater degree than with oxidising filters. This formula holds good with water contaminated with animal matters only; in waters containing much vegetable matter the elimination of the nitrogen is difficult, and my former letter was written principally to call attention to this subject.

I would take this opportunity of requesting Professor Bischoff to determine the ammonia in London waters *passed over spongy iron alone*. The subject of the rapid action of spongy iron deserves attention. I believe it

will be found, that as far as regards removal of organic matter, slow or rapid filtration makes but little difference; in all the experiments I have made the filtration has been effected at about fifteen times the speed at which the Rivers Commission filtrations were made.—I am, &c.

JAMES DEATH.

Laboratory, St. Georges Road, Southwark, S.E.
March 6, 1878.

CHEMISTS AND CHEMISTS.

To the Editor of the Chemical News.

SIR,—"A Credulous Chemist" appeals to his "friend, Professor Attfield," for evidence of my statements respecting the history of the name or title of *chemist*. If he will, by appending his name to his notes, afford me evidence by which to judge of the nature of his credulity and his friendship, I will endeavour to satisfy him. I agree with him that a writer's name to a letter is not a perfect guarantee of the soundness of the writer's statements, but it is at least more valuable than a pseudonym. I will not push the *tu quoque* argument too far; I desire to be courteous, and I am sensible of the value of anonymous writing in our periodicals; but, if he will please excuse me, I would rather not reply to pseudonymous correspondents.—I am, &c.

JOHN ATTFIELD.

Ashlands, Watford.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 5, February 4, 1878.

On Anhydrous Trichloracetic Acid.—A. Clermont—The author obtains this compound by the action of anhydrous phosphoric acid upon trichloracetic acid.

Combinations of Quercite.—L. Prunier.—The author has examined the action of hydrochloric acid upon querite under a variety of circumstances.

Use of the Polarising Microscope with Parallel Light for the Determination of the Mineral Species contained in Slender Discs of Eruptive Rocks.—A. Michel-Lévy.—Not suitable for abstraction.

Leadhillite of Matlock.—E. Bertrand.—The leadhillite of Matlock is identical in its crystallographical form from the specimens found at Leadhills, but its optical behaviour is different.

New Specific Gravity Apparatus.—F. Pisani.—The description of this instrument does not admit of condensation.

Recent Researches on the Function of Moulds and on their Power of Inverting Sucrose.—M. A. Béchamp.—A critique on a paper by M. U. Gayon (p. 52 of the present volume).

On the Telephone.—L. de Champvallier.—The telephone is found to act satisfactorily at a distance of 14 kilos. Morse messages, which pass along wires distant from 45 to 90 centimetres, can be read even when these accompany the telephone wire merely for the length of 300 metres. Two telephone lines adjacent, but not connected, mix their dispatches.

On the Telephone.—A. Demoget.—In front of and at a millimetre distance from the vibrating disc of a Bell's telephone the author places one or two similar vibrating plates, but pierces in the centre of the first a circular orifice equal in diameter to that of the magnetic rod; in the second, an orifice of a larger diameter. He thus augments not merely the intensity of the sounds transmitted, but their distinctness.

No. 6, February 11, 1878.

Observations on a Memoir by M. Dieulafait on Boracic Acid.—M. Bidaud.—M. Dieulafait's method of detecting the existence of 1-100000oth grm. of boron by means of the flame of hydrogen depends on presenting a basic saline mixture containing boracic acid, to which a strong acid has been added, to a Bunsen burner, supplied either with pure hydrogen or common coal-gas. A characteristic green flame is produced when the interval between the saline mixture and the external visible part of the flame is from 2 to 4 m.m. M. Bidaud shows that he called attention to this method in 1873, using tartaric acid to liberate the boracic acid.

Bulletin de la Societe Chimique de Paris, No. 2, January 20, 1878.

Analysis of Silicates by Means of Lead Oxide.—Gaston Bong.—The ordinary methods for the analysis of silicates require high temperatures and leave certain important substances undetermined. The use of oxide of lead obviates these difficulties; the mineral is attacked at a low temperature, which is kept up as long as is necessary for complete decomposition, which is generally effected with ease, and may be promoted by a very fine comminution of the substance under analysis, and by an increase in the quantity of oxide of lead. Ordinarily it is convenient to treat the sample with three times its weight of minium, the purity of which has been previously ascertained. The ignition should take place in a platinum crucible, and the silicate must therefore be previously calcined to remove any carbonaceous matter. The crucible should likewise be ignited in an oxidising atmosphere. When the mass has been well melted in the crucible it is allowed to cool, and then treated with nitric acid, which detaches it readily in a few minutes. The solution is continued in a porcelain capsule, and the whole is evaporated to dryness to eliminate the silica. It is then re-dissolved in nitric acid, avoiding excess, filtered to remove silica, largely diluted with water, and the lead is then precipitated with sulphuretted hydrogen. After filtering off the lead sulphide all the elements present will be found in the filtrate except the silica already determined. For the determination of the alkalies it is merely necessary to precipitate with ammonia, after having added a salt of magnesia or oxalic acid in case of silicates rich in phosphoric acid or in lime. The filtrate generally contains merely the alkalies mixed with the excess of magnesian salt which is separated by known methods. The same method is applicable to the analysis of aluminates.

Extraction of the Platinum Metals as Practised in German Refineries.—M. Opificius.—The ferric chloride resulting from refining gold contains, in addition to gold in suspension, platinum, palladium, silver chloride, iridium, and rhodium in solution, as well as copper, antimony, lead, bismuth, arsenic, tin, selenium, and tellurium. This solution is treated with iron, which yields a pulverulent metallic deposit containing the elements above mentioned. After the mechanical removal of compact fragments of iron, the finely divided iron is removed by digestion with ferric chloride, which dissolves at the same time a part of the copper, and also of the palladium if the digestion is carried too far. The residual deposit is washed with dilute hydrochloric acid, dried, and melted with carbonate of soda and charcoal. The selenium is found in the scoriæ as sodium seleniate. The regulus is granulated and treated with *aqua regia* with an excess of hydrochloric acid insufficient for the removal of all the metal, the first object being to dissolve out the copper as

this metal impedes the separation of platinum and palladium. This operation is repeated several times till all the copper is dissolved. The last solution contains a part of the palladium, which may be re-precipitated by the introduction of fine copper wire. The remaining metal is then entirely dissolved in *aqua regia*, diluted with water to throw down antimony, then concentrated again, and mixed with ferrous chloride to precipitate the gold. It is, however, better to precipitate the gold by the galvanic method and then separate the platinum as chloro-platinate of ammonium, which, on ignition, leaves platinum sponge containing not more than 0·5 per cent of impurities. The mother-liquids from the chloro-platinate containing an excess of sal-ammoniac serve for the precipitation of fresh portions of platinic liquids, and thus at the same time the palladium from several operations is concentrated into one liquid. On concentration the rest of the chloro-platinate crystallises, and in the final mother-liquors the palladium is thrown down as yellow chloride of palladammonium by the addition of hydrochloric acid and ammonia in slight excess.

Applications of Ferro-manganese.—M. Henderson.—The author has succeeded in preparing on the large scale ferro-manganese containing as much as 75 per cent of manganese, and consequently five or six times richer than spiegeleisen, which it supersedes, and proves the antidote to phosphorus.

Action of Potassium Nitrite upon Nitranilide and Acetonitranilide.—A. Müller.—If potassium nitrite is added to a somewhat concentrated aqueous solution of nitracetanilide mixed with nitric acid (1½ to 2 molecules of the nitrite to 1 mol. nitracetanilide), and the mixture is then supersaturated with ammonia, nitrogen is given off, and a red crystalline body is deposited, identical in its properties with Vogel's zinalin. It is sparingly soluble in water, but dissolves with a red colour in alcohol, ether, chloroform, and carbon disulphide. Alkalies dissolve it with a blood-red colour, and acids re-precipitate it in yellow flakes. It dyes silk and wool yellow and orange shades, which turn red on contact with ammoniacal vapours, but resume their former colour on exposure to air. Its salts dye an unstable violet, which passes into orange when washed in water. To obtain it on the large scale 1 part of acetanilide is heated to 75° in 8 parts nitric acid, an equal volume of boiling water is added, and the filtrate is treated with potassium nitrite and ammonia. The composition of this body is $C_{18}H_{13}N_5O_3$ and it is possibly phenol-bidiazonitrobenzol.

No. 3, February 5, 1878.

Memoir on Ultramarines.—E. Guimet.—From this lengthy paper we extract the author's remarks on the part played by each of the constituents of ultramarine. *Oxygen.*—According to the author's experiments the production of the colour is due to this element. In its absence the sulphides cannot generate ultramarines; the presence of hyposulphites is required for the formation of a stable colour. *Sulphur.*—With the same proportions of the other constituents a small amount of sulphur gives a light blue, which darkens as the sulphur is increased. When, however, a certain shade has been reached, depending on the proportions of other substances in the mixture, any further excess of sulphur is eliminated either by volatilisation or as sulphate of soda. *Soda.*—The proportion of soda in ultramarines is always the same, about 20 per cent. Any excess of soda introduced into the original mixture disappears as sulphate. *Silica.*—Its proportion in ultramarines is tolerably constant, from about 37 to 38 per cent, and its function has not yet been clearly defined. *Alumina.*—The shade of the blue depends on the quantity of alumina contained in the original mixture. When the proportion of alumina lessens that of sulphur increases, whilst the relative amounts of silica and of soda do not change. Hitherto the light or pure blue ultramarines and the dark or rosy ultramarines have been respectively designated as poor in silica or rich in silica, while the fact is that they all contain silica in the same proportion.

Preparation of the Alcoholic Chlorides and their Application to the Production of Colouring Matters.—MM. Prosper Mounet and F. Reverdin.—Already noticed.

Preparation of Œnolin.—Eug. Varenne.—Lees of wine are stirred up with lime so as to form a thin blackish grey paste. This is thrown upon a filter, washed, drained, stirred up in alcohol at 95°, and mixed with sulphuric acid enough for the exact saturation of the lime present. The alcohol, which holds the œnolin in solution, is then filtered off and distilled in the water-bath, when the œnolin is left in a dry state. It is used for improving the colour of wines.

No. 4, February 20, 1878.

Remarks on the Memoir of MM. F. Schmidt and B. Tollens on the Lactobutyrometer.—E. Marchand.—MM. Schmidt and Mollens have proposed the use of alcohol at 92 per cent instead of 86 per cent, as originally suggested by the author. He admits that alcohol of the higher strength secures more readily the separation of the stratum of matter to be determined, but states that in milks rich in protein compounds it occasions the formation of a thick magma. He infers that Schmidt and Tollens have evaporated the milk after mixture with sand, and have then extracted the butter by lixiviation with ether. This procedure he condemns as faulty, because the fatty matter imprisoned in the casein and the coagulated albumen escape in part the action of the solvent. He considers that the only method for the exact determination of the butter is to render the milk alkaline by the addition of caustic soda, and then to exhaust by successive washings with ether.

Separation of Vanadium from Iron and Aluminium.—A. Bettendorff.—If vanadic acid is present in solution along with alumina, the addition of ammonia precipitates it as yellow vanadiate of alumina, insoluble in excess. If phosphate of ammonia is added and the mixture heated the precipitate turns white and is converted into alumina phosphate, while the vanadic acid remains soluble as ammonia vanadiate. In presence of ferric salts the reaction is similar. To facilitate the settling of the alumina phosphate, which is washed by decantation, sal-ammoniac is added to the solution.

Reimann's Färber Zeitung,
No. 7, 1878.

The editor, in an able leader, points out that apprenticeship is no longer an adequate method for acquiring a knowledge of the industrial arts.

No. 8, 1878.

This issue contains a critical inquiry into a case of arsenical poisoning which has been commonly ascribed to the industrial use of arseniferous magenta. The writer points out that beer brewed from glucose syrup constantly contains small proportions of arsenic.

MISCELLANEOUS.

Presentation to Dr. Muter.—On Wednesday, March the 6th, the present major and minor Students of the South London School of Pharmacy met their director, Dr. Muter, at the conclusion of the Chemical Lecture, and presented with an address expes sing their respect for him as a teacher, and their warm feeling towards him personally. The address was accompanied with the gift of a silver and crystal *Epergne*, tastefully loaded with fruit and flowers. The presentation was to have been made on the Doctor's birthday (February 27), but owing to a delay in the production of the inscription, &c., it had to be deferred.

Blowpipe Apparatus.—The Council of the Society of Arts having added Blowpipe Analysis to their list of annual examinations, were anxious to obtain a better box of apparatus for qualitative purposes, to be sold retail for a guinea, than any now sold for that sum. To effect this, they offered a prize of £10, with the Society's silver medal, the competition being international. The box selected for the prize was sent by Messrs. Letcher, of St. Day and Camborne, Cornwall. The award was made by the following committee:—Major-General Cotton (chairman of the Council), Professor Abel, F.R.S., Dr. C. Le Neve Foster, Captain Douglas Galton, F.R.S., Admiral Sir Erasmus Ommaney, F.R.S., Mr. E. C. Tufnell, and Professor Warington Smyth, F.R.S.

NOTES AND QUERIES.

"**Safety Matches.**"—Like your correspondent, Bertram A. Muirhead, Lieut. R.N., I found by experiment a long time ago that the "Box" is by no means necessary to obtain a light from these so-called "Safety Matches," as they readily ignite by being brought in contact with other surfaces. Any one can prove this by drawing a match briskly in a continuous line from two to three feet in length along an ordinary rough-boarded dry floor, such, for instance, as those we find at railway stations. The same result can be obtained if drawn similarly along a rough dry Kamptulicon floor, such as used in offices, &c., and I have obtained a similar result, although not so readily, by turning up the sole of the boot and drawing a match briskly across this. I presume these results are brought about as a consequence of the temperature being raised by simple friction. Since reading your correspondent's note I have tried the effect of these "Safety Matches" in contact with coal and find ignition certain and almost immediate. —GEO. TUNBRIDGE, Gas Works, Leicester.

"**Safety Matches.**"—It may not be out of place to mention a fact concerning the so-called "Safety Matches." I have seen them ignited by striking them with an elliptical sweep towards the striker on a glass shop-counter, and, attempting to do likewise, I also ignited one after the third attempt. The polish of the glass had been somewhat worn off, hence, I presume, the ignition must have occured through friction and not through any chemical action.—H. C. STANDAGE.

MEETINGS FOR THE WEEK.

MONDAY, 18th.—Medical, 8.
—— London Institution, 5.
—— Society of Arts, 8. "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," T. Bolas, F.C.S.

TUESDAY 19th.—Civil Engineers, 8.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
—— Photographic, 8.
—— Zoological, 8.30.
—— Society of Arts, 8. (African Section). "Egypt: its Commercial Changes and Aspects," Mr. B. Francis Cobb.

WEDNESDAY, 20th.—Society of Arts, 8. "Emery and Corundum Wheels, for Grinding and Surfacing Metals and other Materials," A. H. Bateman, F.C.S.
—— Meteorological, 7.
—— Geological, 7.
—— Society of Public Analysts, 8. "On the Amendment of the Sale of Food and Drugs Act," A. Wynter Blyth, M.R.C.S. "Experiments on the Determination of the Free Acids of Vinegar," Messrs. A. H. Allen, F.C.S., and R. Bodmer.

THURSDAY, 21st.—Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
—— Zoological, 4.
—— London Institution, 7.
—— Chemical, 8. "On Nitrosamines," Dr. Witt. "On a New Method for the Volumetric Estimation of Cyanides," Mr. J. B. Hannay. "On Certain Bismuth Compounds," Mr. M. M. P. Muir.

FRIDAY 22nd.—Royal Institution, 8. Weekly Meeting. "Recent Experiments on Fog Signals," Prof. Tyndall, 9.
—— Quekett Club, 8.

SATURDAY, 23rd.—Royal Institution, 3. "Gleanings from the Natural History of the Ancients," Rev. W. Houghton.

ERRATA.—P. 89, col. 2, line 5 from bottom, *for* "Bishop's" *read* "Hislop's." P. 97, col. 2, line 14 from top, *for* "either a yellow, yellow-green, or blue-green," *read* "either a yellow-green or blue-green."

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 956.

SHORT REPORTS FROM THE CHEMICAL LABORATORY OF TRINITY COLLEGE, DUBLIN,

By J. EMERSON REYNOLDS, M.D.
Professor of Chemistry, University of Dublin.

No. IV.*

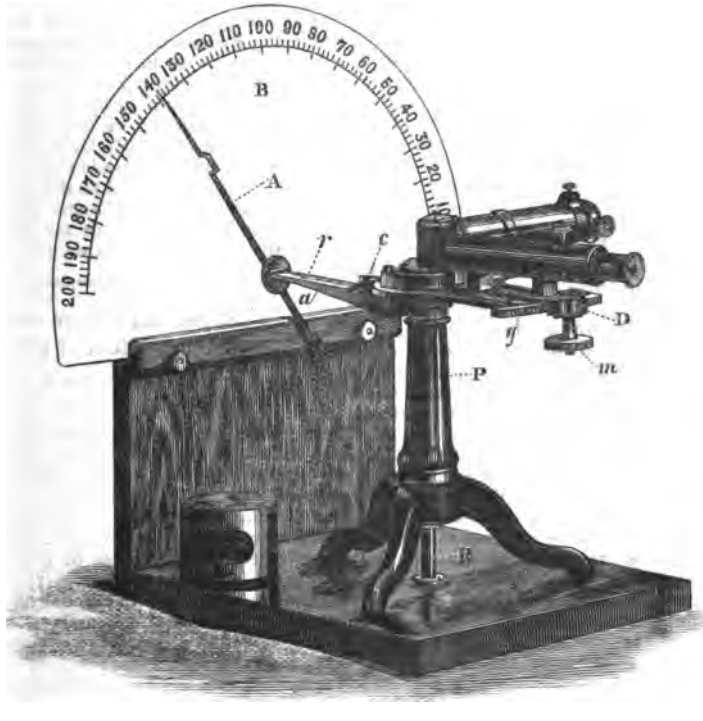
On a New Form of Measuring Apparatus for a Laboratory Spectroscope.

THE measuring apparatus for a laboratory spectroscope which I have been asked to describe, was fitted about a year ago to an instrument in common use in the College Laboratory, and has afforded very satisfactory results. My chief aim in planning the arrangement, was to facilitate the measurement and identification of spectral lines and the mapping of spectra under circumstances admitting of little general illumination.

The spectroscope to which the apparatus is fitted has two fixed flint glass prisms, the refracting angle of each being 60°. This instrument is shown in the annexed engraving. When in use the prisms are covered by a brass cap provided with openings for the collimating and observing telescopes. The movable arm D that supports moves in front of a graduated plate of opal glass, the the observing telescope, also carries a vernier, which is moved with the telescope over a graduated arc, and in this usual way the relative positions of the several lines of a given spectrum can be determined. The angular distance traversed in passing from the extreme red to extreme violet is necessarily small owing to the low dispersive power of the instrument; but this, I need scarcely say, is an advantage rather than the reverse in a spectroscope, which is commonly employed as an aid in ordinary qualitative analysis.

The graduations of the arc are unavoidably close and difficult to read in a feeble light; consequently the eyes of the observer become speedily tired and unfitted for the examination of faint spectra. Nevertheless, measurements made with the graduated arc and vernier are, in my experience, more trustworthy and satisfactory than those obtained with even the best photographed scale that I have had the opportunity of working with. Desiring, then, to retain the method of direct angular measurement, I sought to multiply the motion in such a manner as to obtain wide readings on a convenient scale. After many trials in different directions the form of apparatus which I shall now describe was finally adopted.

Description of the Apparatus.—The annexed woodcut, which is taken from a photograph, represents the whole apparatus. The index A attached to the spectroscope,



latter being supported in the manner shown by the stand S,* to which the spectroscope is also screwed by means of the rod R. The index is attached to a milled head which moves stiffly on a stout steel rod *r*; the latter can revolve in little bearings supported by the projecting arm of "angle brass" *a*, the other end of the rod being let into a hole drilled in the head of the pillar, P, of the instrument. On the rod just mentioned, and immediately

* For Report No. I., "On Glucinum; its Atomic Weight and Specific Heat," see *Philosophical Magazine* [5], vol. iii., p. 38; for No. II., "On a New Mineral Borate," and for No. III., "On an Analysis of Lievrite, by Mr. Early's Method," see *Phil. Mag.* [5], vol. iii,, pp. 284 and 287.

* The stand is of stout walnut wood. A rebate of the thickness of the glass plate is cut to the depth of three centimetres from the vertical piece of the stand. The straight edge of the plate is laid in the groove and is there secured, in part by a pin passing from behind through a hole drilled in the glass, and in part by a wooden slip screwed on in front.

conversation can be carried on at considerable distances by simply employing stretched wires provided with suitable vibrating discs. In one experiment two copper wires were attached to points on a telegraph wire 150 yards apart, and breathing, singing, &c., were distinctly audible; by stretched wires extending through a house and provided with mouth- and ear-pieces in the several rooms conversation could be carried on without difficulty. The materials employed for terminals were very varied, and the vibrating disc, whether metal, wood, india-rubber, &c., was generally formed as a drum head, the wire being fastened at its centre. The volume of sound appears to be greater with a heavy wire, but in all cases it requires to be stretched.

The PRESIDENT referred to the experiments of Wheatstone on the conduction of sound by vibrating bodies, especially long wooden rods. He mentioned that in 1856 a performance was given at the Polytechnic, at which numerous experiments connected with such conduction were exhibited. Some years ago M. Cornu, in conjunction with M. Mercadier, made experiments which showed that vibrations can be transmitted along a copper wire, and rendered visible at the distant end on a rotating blackened drum. The free end of the wire was attached to a piece of copper-foil fixed at its base, and provided with a point which left a clear trace on the drum when the distant end was attached to, say, a vibrating tuning-fork. By connecting such an arrangement with different instruments, and varying the players also, M. Cornu has ascertained the form and extent of vibration corresponding to each. The arrangement adopted by him was exhibited by Prof. Adams, and in conclusion he referred to a passage in Hooke's "Micrographia," which clearly showed that he was aware of the facility with which sounds can be transmitted to a distance by solid bodies.

Mr. W. H. PREECE described some experiments made in September of last year by Mr. A. W. Heaviside and Mr. Nixon at Newcastle-upon-Tyne on this subject, from which they conclude that the method might certainly be applied with success to the transmission of speech within a building. They find that a No. 4 wire gives the best results. The terminals were wooden discs about ¼th in. thick, and to these the wire was attached "end on," but speech could be distinctly heard by laying such a disc on any intermediate point of the wire. When the wire was particularly still speech was audible up to 200 yards.

Mr. G. W. von TUNZELMANN then read a paper on the "*Production of Thermo-electric Currents in Wires Subjected to Mechanical Strain.*" The wire of iron, steel, or copper was stretched vertically between two cans, which could be maintained at different temperatures. It was fixed in the base of the lower can, and held in the upper one by a clamp attached to the shorter arm of a lever, to the longer arm of which the stretching weight was applied. The free ends of the wire were joined to copper wires, which led to the Thomson galvanometer, these junctions being covered with cotton-wool. He has succeeded in reconciling the contradictory conclusions arrived at by Sir W. Thomson and M. Le Roux, for whereas the former only used moderate strains, the latter worked near the breaking limit, and the author finds that if the weight be gradually increased the direction of the current changes, and hence these two authorities found the currents to flow in opposite directions. A great number of experiments were made, and from them it is evident that on applying a strain the deflection does not immediately attain a maximum, but it gradually rises for about eight minutes and then gradually falls, attaining a stationary point at the end of about twelve minutes. Experiments in which the weight was rapidly put on and taken off led him to conclude that, besides the permanent, there is a transient effect produced by the strain, and this latter only he considers to be due to a change of molecular state.

Prof. ADAMS then exhibited a simple arrangement for projecting Lissajous's figures on to the screen, which has been made by his assistant, Mr. Furze. It consists of two strong straight steel springs, fixed in separate heavy iron frames, the one horizontally and the other vertically. The latter carries at its end a double convex lens, and the former carries a black disc perforated with a small hole, and is so mounted that its length may be varied as required. If now the disc be placed before the lamp and the point of light be focussed on the screen by means of the lens on the vertical spring, the two springs may be caused to vibrate, and the spot will describe a figure corresponding to their relative rates.

Prof. MCLEOD referred to an analogous arrangement in which the spot and lens are replaced by two slits in black discs at right angles to each other.

Dr. GUTHRIE exhibited an experiment to show the behaviour of colloids and crystalloids in relation to electrolysis. A solution of gelatine was coloured with litmus, made acid, and mixed with sulphate of soda; two platinum poles of a six-cell Groves battery were then immersed in it, and the gelatine was allowed to set. The mass became comparatively clear round the positive pole and red and blue clouds were formed, which met across a space of about 1½ inches in three-quarters of an hour. The relative advance of the ions was indicated by the brightening of the litmus round one pole and by the blue colouration produced at the other.

UNIVERSITY COLLEGE CHEMICAL AND PHYSICAL SOCIETY.

THIS Society has lately transacted the following business:—

Thursday, December 13, 1877.—Dr. C. A. Bell, Vice-President, in the chair. Paper on "*The Microscope and Accessory Apparatus*," by Mr. CHARLES J. WILSON.

Thursday, January 18, 1878.—Dr. Oliver J. Lodge, President, in the chair. Paper on "*Mechanical Illustrations of Electrical Phenomena*," by Dr. LODGE.

Thursday, January 31.—Dr. C. A. Bell, Vice-President, in the chair. Paper on "*Chemical Dynamits*," by Dr. BELL. Paper on "*Salt in Beer and Brewing Materials*," by Mr. H. BROWN.

Thursday, February 14.—Mr. R. H. Wright, Vice-President, in the chair. Paper on "*The Production of Thermo-Electric Currents in Wires Subjected to Mechanical Strain*," by G. W. VON TUNZELMANN.

Thursday, February 28.—Mr. R. H. Wright, Vice-President, in the chair. Paper on "*The Study of the Physical Properties of Bodies in Connection with their Chemical Investigation*," by J. SAKURAI. Paper on "*The Manufacture of Oxalic Acid*," by CHARLES E. CASSAL (Hon. Sec.).

Thursday, March 14.—Mr. Harrison, B.Sc., in the chair. Paper on "*The Carbo-hydrates*," by FRANK L. TEED. Paper on "*Butter Analysis*," by Mr. H. ROBSON, B.Sc.

A paper on "The Transmission of Power by Water under Pressure" will be read by Mr. Paul Nolet, at the next meeting of the Society, to be held on Thursday, March 28, at 7 p.m.

NOTICES OF BOOKS.

Photographed Spectra: One Hundred and Thirty-Six Photographs of Metallic, Gaseous, and other Spectra, &c. By J. RAND CAPRON, F.R.A.S. London: E. and F. N. Spon. 1877.

MR. CAPRON has done good service to the science of spectroscopy in publishing this very beautifully executed series of photographic spectra. Photography is a most valuable handmaiden to spectroscopy in this respect, for the cleverest draughtsman, working with the most perfect

micrometer, cannot expect to rival the accuracy of a good photograph. Besides, these photographs may be enlarged within certain limits, and compared with one another at leisure, so as to reduce the chances of error to a minimum. The plates are 136 in number, exclusive of a supplementary plate of the solar spectrum showing Rutherford's bright oxygen lines. The spectra include those of most of the heavy metals, the elementary gases, and several compounds, such as silicic fluoride, tri-chloride, coal gas, olefiant gas, &c. The spectroscope employed for the metals is a direct vision 5-prism instrument, dividing the D lines easily with a low eyepiece. It was fitted to an ordinary camera, the telescope and eyepiece being replaced by a projecting lens of 9 inches focus. It seems a pity, by the way, that such a very rough sketch of this apparatus should have been given. Although intelligible to the practised spectroscopist, we fear it will only puzzle the ordinary student to make head or tail of it. The metallic spectra were obtained both from the spark and the electric arc, a Ruhmkorff coil with condenser giving a very brilliant $\frac{1}{4}$ to $\frac{1}{2}$ an inch spark being used for the former purpose, and 40 pint Grove cells for the latter. Mr. Capron has confined his researches more especially to the violet end of the spectrum, ranging from about E or *b* to H_1 or H_2 in the violet. The exposure for the spark spectra averaged about fifteen minutes, the arc spectra, which were very bright, from three to five minutes. The images in the camera were two inches long, the plates being afterwards enlarged to double that size. For the gaseous spectra, three different instruments were used—one similar to that used for the metallic spectra; a spectroscope with two quartz prisms, the collimating and projecting lenses being also of quartz; and, lastly, an instrument constructed with the special view of photographing faint spectra. The impressions from this instrument are quite small, being less than half an inch in length, but so extremely sharp that they will bear enlarging nine or ten times without loss of definition. The spectra obtained from the metals are mostly very beautiful, especially those of Cu (arc), Di, Er, Fe (arc), meteorite (arc), Ag (arc), Tl (arc), Ti (arc) and Va (arc).

A description of each print is given in the text, stating how the spectrum was obtained, and other interesting details.

The gaseous spectra were not so successful on the whole, bromine and chlorine refusing to give any spectra at all, the tubes breaking down before they had been lighted a sufficient time to give an image. With iodine vapour Mr. Capron was more successful. No doubt these difficulties will be overcome in time, and that before long we shall have photographic spectra of all the gases as well defined as those of N, NH_3, and coal gas.

The photographs have been very beautifully reproduced in permanent colour by the Autotype Company.

Although far from being a perfect work, from causes at present beyond the author's control, it cannot fail to be of great service to all classes of spectroscopic observers.

Year-Book of Pharmacy, comprising Abstracts of Papers Relating to Pharmacy, &c., contributed to British and Foreign Journals from July 1, 1876, *to June* 30, 1877. London: J. and A. Churchill. 1877.

THE year ending June 30th, 1877, was comparatively fruitless in great pharmaceutical events interesting either to the scientific chemist or the pharmacist. It has not, however, been wanting in research, and the papers of Messrs. Wright, Groves, Williams, Paul, and Kingzett (on the alkaloids contained in *Aconitum napellus* and *Aconitum ferox*), are models of what such researches should be. The so-called aconitine of commerce, which was at one time thought to be the pure alkaloid, contains a mixture of three distinct alkaloids—pure aconitine, a highly active crystallisable body, and giving crystallisable salts; pseudaconitine, also highly active and crystallisable, but not readily yielding crystallisable compounds; and an amorphous, bitter, physiologically inert base, picraconitine, furnishing well crystallised salts. So far the alkaloids contained in *A. napellus*. *A. ferox*, the Japanese variety of the plant, contains a much larger proportion of pseudaconitine and a much smaller one of aconite than its European congener. It also contains a fourth alkaloik, according to Messrs. Paul and Kingzett; but Dr. Wright looks on this body as pseudaconitine and mixed decomposition products thereof. This part of the subject, however, is at present under investigation. The other chemico-pharmaceutical researches contained in this volume are of comparatively small scientific interest.

Amongst the papers read before the Pharmaceutical Conference at Plymouth, those on the aconite alkaloids undoubtedly bore off the palm; but there are others of great merit. It seems, however, to be a pity that certain members of the Conference should take up subjects for investigation which do not in any way concern pharmacy proper. We allude to such papers as those on "Oil of Sage," "Hederic Acid," "The Proximate Principles of Narcissus," and several others. Such subjects as these not only properly belong to the domain of the scientific chemist, but, as far as one can see at present, they are not in the slightest degree connected with pharmacy. With so many urgent pharmaceutical questions crying out for investigation, it seems worse than a waste of time to encroach on ground already occupied.

Proceedings of the Twenty-fifth Annual Meeting of the American Pharmaceutical Association held at Toronto, Canada, September, 1877. Philadelphia: Sherman and Co. 1878.

THE American Pharmaceutical Association met for the first time last year over the border of the United States, their twenty-fifth annual meeting being held on British territory at Toronto, Upper Canada. In looking through the list of papers read at the meeting, one cannot help being struck with their practical character as compared with those read before our own Pharmaceutical Conference. There is not a single one which does not more or less elucidate some important point in practical pharmacy. Here we find no *dilettante* reseaches into esoteric questions: every paper has its practical purpose and bearing. We should advise the younger and more ambitious members of our own Pharmaceutical Conference, many of whom seem to prefer chemistry to pharmacy, to study the list of questions given out to the members of the American Association for investigation; out of the whole fifty-six there is not one which is not intimately connected with the every-day work of the practical pharmacist. One of the most interesting chemical papers is that by Mr. H. S. Wellcome, of New York, on "The Bromine Production of the United States. From this paper we learn that the production of bromine in the United States has now reached 1000 lbs. a day, but the amount of raw material, waste bittern, available for producing this element would yield three times that quantity. The principal salt works which produce bromine in the United States are four in number, and are situated in Western Virginia and Ohio, the largest manufactures being Herman Lemer, of Mason City. The Ohio and Kanawha salt region produces bittern which is twice as rich in bromine as any other yet discovered. Singularly enough the Syracuse and other New York and Western bitterns do not contain a trace of bromine. Owing to the high price of bromine in Europe several lots were exported last year, in all about 50,000 lbs. As no steamship will carry bromine, and as it is very difficult to induce other vessels to take it at any price, it is only under exceptional circumstances that American bromine appears in the European market.

Next year the meeting of the Association will be held in Atlanta, in Georgia. Strangely enough, this will be the first time that the Association has met in any of the Southern States, where it is said that pharmacy is at a very low ebb.

English pharmacists will do well to study this volume, not merely for the sake of the information it contains, but in order to learn how a Pharmaceutical Association having precisely the same objects as their own should be carried on.

The active members of the Association number over 1000.

CORRESPONDENCE.

ON THE APPLICATION OF SONSTADT'S SOLUTION TO THE SEPARATION OF MINERALS FOR CHEMICAL ANALYSIS.

To the Editor of the Chemical News.

SIR,—Mr. Hardman, in his paper in your last number, on "The Application of Sonstadt's Solution to the Separation of Minerals for Chemical Analysis," claims, I think, more than is quite fair when he writes of his own application of the liquid to such a purpose as "perhaps the first."

Just four years ago, my "Note on a New Method of Taking Specific Gravities, Adapted for Special Cases," appeared in your journal; and in that paper I gave an illustration of the bearing of the method upon analysis by describing how impurities in certain alkali salts could be quickly and with certainty detected by its means. I stated also that I had "found the method very convenient . . . . whenever wanting to know the sp. gr. of any mineral not so heavy as to sink in such a liquid as could be conveniently made and used."

After describing how iodide of ethyl may be used for substances of less sp. gr. than 2·0, I go on to describe the liquid to which Professor Church has done me the honour to attach my name, and state that I had tested "many minerals by it." In the last two paragraphs of my paper I especially point out that different minerals may readily be thus distinguished. Taking quartz as an example of a mineral from which others are to be distinguished, the words in the paper are "As many minerals closely resemble quartz in external characters, *and can be distinguished more readily by their specific gravity than in any other way, this method of testing the specific gravity furnishes a very quick and certain means of discrimination.*" In the last paragraph I suggest, further, that gems may by this liquid be separated from quartz sand. Long before writing my paper, I had used the liquid in the examination of residues from chemical processes, and for discriminating minerals from the matrix in which they were bedded, but I thought it unnecessary to specify every case in which the liquid might be applied, all such applications following naturally when once it was pointed out how readily minerals differing in sp. gr. might be distinguished.

Mr. Hardman refers to Professor Church as having "noted the applicability Sonstadt's solution to the separation of minerals," &c. I think I may fairly claim to have shown this applicability in my original paper; and I must do Prof. Church the justice to say that he gave me my due when, in describing the identification of gems by this method in a paper published in the *Quarterly Journal of Science*, he, in a foot-note, writes, "as proposed by Mr. Sonstadt," or words to that effect.

Although I am glad to find that the utility of the method proposed by me for separating substances of different specific gravity is begining to be recognised, yet it seems that one application of a heavy liquid that I suggested and referred to examples of, remains neglected —I refer to the different specific gravity of different parts of crystals which becomes apparent when they are suspended without weight.

In my paper I specify crystals of chloride of potassium, which, when prolonged on one axis, have one end specifically heavier than the other. I found crystals of alum always to have a heavy side, and it seems probable that experiments on a variety of crystals of different substances would lead to interesting results. Clearly it would be possible so to *weight* the lighter end or side of a crystal as to make a quantitative determination of the difference of specific gravity between different parts possible.—I am, &c.,

E. SONSTADT.

75, Churchill Road, N.W., March 18, 1878.

THE CHEMICAL PROFESSION IN AUSTRALIA

To the Editor of the Chemical News.

SIR,—I was very pleased to learn from an October number of the CHEMICAL NEWS, that the long correspondence which took place in your columns on the necessity of an organisation among chemists had resulted in the formation of "The Institute of Professional Chemists of Great Britain and Ireland."

I would, on behalf of the few qualified chemists who have had the misfortune to cast their lot in this and other colonies, ask the new association to extend its arm of protection to Australia and New Zealand.

So far as Victoria—the most prosperous of the Australian colonies—is concerned, I can state that the quack element has so degraded the profession that several trained chemists, one of whom is a B.Sc., have, through sheer necessity, had to accept common clerkships.

During the two years I have been lecturing in this country I have urged upon the Government the desirability of encouraging the study of the physical sciences, and more especially of chemistry, and from what I learn it is more than likely that it will do so.

In order, therefore, that the colonial public may have reliable analysts and lecturers, I would ask the Institute to extend its influence to the British colonies, and more especially to Australia.

Unless he comes out under engagement, a chemist has, in the present state of affairs, a very black look out indeed.—I am, &c.,

R. W. EMERSON MACIVOR,
F.C.S., Memb. Phys. Soc., &c.

Chemical Laboratory, 29, Queen-street, Melbourne.
Jan. 8, 1877.

CHEMISTS AND CHEMISTS.

To the Editor of the Chemical News.

SIR,—I am sorry Professor Attfield has not taken in good part my well-meant endeavour to sustain him in what, but for the robustness of my faith in his authority, I should now begin to fear was an untenable position. Very little was requested of him, nothing but what he might have supplied to the humblest of inquirers. Not an elaborate letter, not even a citation of extracts was asked for, but only, and for the benefit of your anonymous readers whom he had himself volunteered to enlighten, a reference to the particular passages or records on the strength of which he had put forth certain historic statements of quite exceptional interest. But, instead, he shrouds himself in his dignity,

> "As who should say, 'I am Sir Oracle,
> And when I ope my lips, let no dog bark.'"

I have little doubt, however, that Professor Attfield—and this time I will be very respectful, my former unlucky reference to "my friend, Professor Attfield," seeming to be considered a liberty, although, indeed, he and I have known each other many years, and my signature is, I believe, attached to his Royal Society certificate—I have little doubt, I say, that Professor Attfield has an excellent reason for his present reticence, and a better reason consequently than the one he has put forward. For myself, as still retaining the conviction, though just a little

shaken, that the designation of chemist pertains only secondarily to the student and worker, and primarily and distinctively to the dealer in chemicals, I again venture to subscribe myself as your obedient servant,

A Credulous Chemist.

London, March 19, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 7, February 18, 1878.

Refutation of the Criticisms which M. Pasteur has Published on my Opinions Concerning the Origin of Ferments, Alcoholic and Lactic.—A. Trecul.—A controversial paper of little general interest.

The Vibrations of Matter and the Waves of the Ether in Sight.—M. Favé.—If we admit that all matter is endowed with a system of persistent vibrations, we are led to consider vision in a new light for the transparent cornea, the aqueous, the crystalline, and the vitreous humour can be no longer regarded simply as concerns the refraction which they produce. It must be admitted that the vitreous humour exerts all the vibrations to be communicated to the optic nerves, and that these are able to select the vibrations which they are capable of executing to produce distinctly the sensation which remains an insoluble problem. By admitting that the waves of the ether communicate their motion to the synchronous vibrations of different parts of the eye we may refer to physics certain facts hitherto considered as purely physiological. The eye if closed for a time, sufficiently long not to experience any sensation of light, undergoes, nevertheless, the constitutive vibrations of its component matters, but in this state the vitreous humour does not impart to the nerves a *vis viva* sufficient to produce sensation. The eye, again, is opened and receives waves capable of augmenting certain vibrations of the vitreous humour, but time is required in order that the vibration may acquire the needful intensity. If the minimum intensity indispensable for sensation has been exceeded and the eye is again closed the sensation does not cease immediately, for the *vis viva* aquired must first be transferred to the ether.

Presence of Magnetic Globules Analogous to those of Atmospheric Dust in Rocks Belonging to Ancient Geological Epochs.—MM. Meunier and Tissandier.—The facts observed by the authors show that the present sediments of the sea, like those of the geological oceans, contain globules like those which the atmosphere constantly lets fall upon the surface of the earth.

Separation of the Non-ferruginous Components of Rocks, Founded on their Difference in Specific Gravity.—M. Thoulet.—The specific gravity of the majority of the essential minerals of rocks varies between 2·2 and 3. Hence, to separate these minerals from each other, they may be immersed in a solution without chemical action upon them, and whose specific gravity is comprised between the same limits. For this purpose a solution of iodide of mercury in iodide of potassium saturated at 11° may be used, as its sp. gr. is 2·77.

The Telephone of Bell and the String Telephone.—A. Breguet.—The author has examined the influence of the thickness of the iron plates upon the reception of sound by Bell's telephone, and finds that it has no limits

On Telephony.—G. Salet.—The general problem of telephony, the transmission of speech to a distance, seems at first to be identical with this: to render the movements of a membrane connected with those of another membrane situated at a great distance in such a manner that to every displacement of the former a displacement of the latter, proportional and in the same direction, may correspond.

Ebullition of Superposed Liquids.—D. Gernez.—In a vacuum a mixture of two liquids without chemical action upon each other emits vapours whose tension is almost rigorously equal to the sum of the maximum tensions of the two vapours at the same temperature.

Extraction of Gallium.—Lecoq de Boisbaudran and E. Jungfleisch.—The small proportion of gallium in the minerals containing it renders the preparation of this metal costly and laborious. The authors have followed a method which enables them to attach its preparation to that of a commercial product, the sulphate of zinc, and to operate at first industrially upon important masses. M. Leon Thomas has under their guidance treated 4300 kilos. of the blende of Bensberg, the richest ore known. The pulverised mineral is roasted in a Perret furnace, when the gallium remains fixed, while the greater part of the indium is volatilised. The residue is treated with a quantity of sulphuric acid sufficient to dissolve almost all the zinc, leaving, however, in the mass so much subsulphate of this mineral that the filtrate may be rendered turbid by cold water. We obtain thus, commercial sulphate of zinc and a residue containing the gallium. This residue is re-dissolved in an excess of sulphuric acid. After the reduction of the per-salt of iron by means of metallic zinc, the filtrate is precipitated fractionally with carbonate of soda, the progress of the operation being watched with the spectroscope. The precipitates are re-dissolved in sulphuric acid, and a second reduction with zinc and a fractionated precipitation with carbonate of soda follow. All the gallium in the 4300 kilos. of ore was thus concentrated in about 100 kilos. of still moist material. To remove the iron the reductions with zinc and the fractionated precipitations with carbonate of soda are repeated several times. The galliferous precipitate is re-dissolved in sulphuric acid, evaporated to the elimination of most of the excess of acid, and boiled with much water. The filtrate deposits a sediment containing titanic acid. The liquid, which is very acid and much charged with zinc, is treated with sulphuretted hydrogen, mixed with acetate of ammonia, and anew treated with sulphuretted hydrogen. Sulphide of zinc is thrown down along with gallium, which is thus freed from alumina. The additions of sulphate of zinc, of acetate of ammonia, and the currents of sulphuretted hydrogen are repeated as long as the sulphide gives the rays of gallium. The sulphuric solution of the galliferous sulphides of zinc is carefully fractionated with carbonate of soda, and guided by spectral examination the zinc is thus exactly separated. Being again dissolved in sulphuric acid in the quantity exactly necessary we further separate with sulphuretted hydrogen a little cadmium, lead, indium, zinc, &c., and the liquid, largely diluted with water, is raised to a boil. By filtering when hot we collect a bulky sub-salt of gallium which is immediately washed in boiling water, for on cooling it dissolves in its mother-liquor. This basic salt is very readily attacked by potassa, which leaves undissolved iron, indium, &c. The alkaline liquor on treatment with sulphuretted hydrogen gas, and then very slight acidulation with sulphuric acid, yields a deposit principally consisting of sulphide of indium. The very slightly acid liquid is next boiled with a large excess of water, when the sub-salt is again deposited. Metallic gallium is isolated by the electrolysis of the potassic solution of the sub-salt. The metallic deposit is only obtained advantageously under certain special conditions. The intensity of the electric current should vary according to the state of the liquid, but the surface of the negative electrode must be small in comparison with that of the positive electrode. If the metal is deposited in the cold it often forms long rows of crystals resembling needles fixed to the electrode by one

of their ends, and sometimes reaching 3 centimetres in length. Above 30° the metal flows in drops, which collect at the bottom of the electrode. The crude metal has been further purified by filtering it through dense linen, shaking it while hot with water acidulated with hydrochloric acid and repeated re-crystallisation.

Volumetric Method of Determining Potassa.—A. Carnot.—This method is a transformation of that made known by the author in the *Comptes Rendus* for July 31 and August 7, 1876, and June 25 and July 30, 1877, depending on the precipitation of the double hyposulphite of potassa and bismuth in an alcoholic solution. The new method consists in determining, by means of a standard solution of iodine, the proportion of hyposulphurous acid in an aqueous solution of the same salt. The iodine solution employed is decinormal, as recommended by Prof. Mohr; 12·7 grms. of pure iodine being dissolved in water by the aid of about 18 grms. of potassium iodide, and the solution made up to 1 litre. The solution of calcium hyposulphite contains, per litre, 200 grms. of the crystalline salt. The solution of bismuth contains per litre about 100 grms. sub-nitrate, and a sufficient proportion of hydrochloric acid and alcohol. For each operation 1 grm. of the salt to be analysed is taken, or a quantity which may contain at most 70 centigrms. potassa, and it is dissolved in about 10 c.c. of water. If the salt contains much sulphate, chloride of calcium is added (1 grm. of this salt dissolved in water, or a corresponding quantity of pure calcium carbonate dissolved in hydrochloric acid is fully sufficient for 1 grm. of sulphate), and the mixture is left for a few minutes in order that the calcium sulphate may have time to precipitate. Into the same flask are poured successively 10 or 20 c.c. of the solution of bismuth, according as the quantity of potassa is presumably below or above 30 centigrms.; an equal volume of the hyposulphite of lime is next added, and, lastly, from 100 to 150 c.c. of concentrated alcohol. The whole is well stirred up and left to settle for a quarter of an hour. The precipitate of double hyposulphite, whether mixed with sulphate of lime or not, is collected on a filter and carefully washed with alcohol. The funnel is then set over a flat-bottomed flask and cold water is poured upon it with the washing bottle, when the hyposulphite dissolves rapidly. The portion of calcium sulphate which may dissolve at the same time does not interfere with the subsequent operations. A little clear starch paste is then added to the solution, and a few c.c. of hydrochloric acid. The standard iodine liquid is then added with a burette until a deep brown tint appears in the liquid. The volume of the iodine solution employed is then read off, and the weight of the potassa is thence calculated.

Dissociation of the Hydrate of Chlorine.—M. Isambert.—The author has undertaken to measure by direct experiment the tension of the chlorine given off by the hydrate at different temperatures.

Action of Chloride of Benzoyl upon Leucin.—A. Destrem.—The products are $C_{12}H_{24}N_2O_3$, a white amorphous powder, and $C_{26}H_{32}N_2O_5$, a yellow amorphous body very soluble in alcohol.

Identity of Muscular Inosite and the Vegetable Sugars of the same Composition.—MM. Tauret and Villiers.—Inosite is a sugar very widely distributed in nature. A sugar of the same composition has been found in peas, green lentils, acacia cabbage, digitalis, potatoes, asparagus, and two cryptogamous plants.

Preparation of Amylen.—A. Etard.—If a mixture of the alcohols of fermentation is treated with chloride of zinc the result comprises much amylen and little of its polymers.

Experimental Researches on the Maturation of Grapes.—C. Saint Pierre and L. Magniers.—Grapes when ripening evolve carbonic acid, whether in the dark or on exposure to light.—This disengagement takes place in inert gases as well as in the air. The quantity of carbonic acid produced is always greater than the quantity of oxygen consumed. Grapes are capable of absorbing or of losing water, according as they are kept in a damp or a dry locality. As the ripening advances the acids diminish and the sugar augments. The mechanism of ripening is as follows:—The acids and the glucose are formed in the plant and the sap conducts them to the fruit. The acids are burnt there, while the sugar is concentrated. When the ripening process is very far advanced the sugar is burnt in its turn.

No. 8, February 25, 1878.

Carburation of Nickel by the Cementation Process.—M. Boussingault.—Nickel, like iron, is magnetic, sufficiently ductile to be forged and drawn into slender wire. Its point of fusion is very high, and if melted in a *brasqué* crucible it yields a homogeneous regulus of a silvery whiteness, containing carbon. The author has examined whether nickel, like iron, when carburetted, is capable of being tempered and acquires elasticity, and whether it renders steel less susceptible of oxidation. The result was decidedly negative, except that alloys of iron or steel with large proportions of nickel, 30 per cent and upwards, resist the oxidising action of air and water.

New Product of the Oxidation of Lead, and Certain Phenomena of Dissociation.—H. Debray.—There exists a sesquioxide of lead, or rather a compound of plumbic acid and protoxide of lead in equal equivalents, quiet distinct from the sesquioxide, commonly so-called, which is merely a mixture. The sesquioxide of lead is not decomposed by the influence of heat, as is the general case with direct compounds, like the carbonate of lime. Such bodies, if heated in a limited space at a temperature where their decomposition begins, cease to be decomposed when the temperature of the gas evolved in the apparatus has acquired a certain value depending solely on this temperature. But the sesquioxide of lead is split up into oxygen and minium, which, at least in the circumstances indicated above, is not capable of re-oxidation. The sesquioxide, therefore, under the influence of heat behaves like lead carbonate, or any other indirect compound.

The Battery Telephone.—Th. du Moncel.—Experience shows, contrary to what might be *a priori* imagined, that the telephone of Bell with induced currents is more sensitive at a distance than those with a battery. This inferiority may perhaps be ascribed to the alteration of the contacts of the transmitting telephone by the spark of the galvanic current. If, on employing for the transmitting telephone, the plumbago system of Edison, and for the recipient the system of Bell, we pass the galvanic current across the inductive helix of a Ruhmkorff's apparatus, the induced wire of which is connected with the coil of the receiving telephone, the latter, which may have produced no sound under the mere influence of the galvanic current, may, nevertheless, yield very distinct sounds under the influence of the induced currents derived from the former, and the effects occasioned by the galvanic currents may thus be reinforced phonetically.

The Vibrations of Matter and the Waves of the Ether in the Act of Ebullition.—M. Favé.—The author, referring to Gay-Lussac's observation that water boils at a higher temperature in a glass vessel than in one of metal, and to his suggestion to prevent succussions in the distillation of sulphuric acid by putting fragments of platinum wire in the retort, states that he is in a position to explain these facts. The wave-lengths of the solar spectrum vary from 220 to 4800 millionths of a millimetre. Each of the vibrations of matter which gives rise to these waves possesses a certain quantity of *vis viva* which is manifested by the effect of heat, only this heat is sometimes too small to be recognised by our instruments. In the solar spectrum the thermic action increases from its minimum in the violet to a certain distance beyond the red, after which it declines to a point where it disappears entirely. Thus the *vis viva* of the solar vibrations in-

creases with their duration up to a maximum, after which it decreases. Hence, a distinction must be made between vibrations whose lengths differ, for two dissimilar substances cannot always communicate to each other all their excess of heat. From the fact that the ebullition of water is effected in an iron vessel and in a glass vessel we may infer that both transmit to the water all the vibrations necessary to form its vapour, but if the ebullition takes place at a higher temperature in the glass than in the metal it is because the glass requires a more elevated temperature than the tin plate to be in a condition to give to all the vibrations indispensable for watery vapour the necessary intensity. The system of the vibrations of the source of heat, if it is not in harmony with that of the vibrations of the vessel, may also retard ebullition. To these two causes it must be ascribed that ether, which over the naked fire boils at 44°, has been raised to 65° in the water-bath.

Certain Consequences of the Constitution of the Solar Spectrum.—A. Cornu.—The author has been led to the conclusion that the position and relative brightness of the dark rays of the solar spectrum may be explained by the action of an absorbent stratum existing upon the sun, analogous in its chemical composition to that of volatilised aërolites. He infers also that the centre of the earth consists chiefly of metallic masses, and especially of iron.

Transient Variation of Permanent Magnetism.—J. M. Gaugain.—The transient variation of a bar is positive when the bar has been magnetised at a temperature of about 350° and negative when the magnetisation has been performed at any temperature not exceeding 100°. The temperature at which the transient variation = o varies in different bars of steel.

Action of Boron Fluoride upon Organic Substances.—Fr. Landolph.—On treating ordinary camphor with boron fluoride the author obtained as results of the reaction cymene and certain of its polymers and two carbides of the series C_nH_{2n-2}. The gases given off are boron fluoride, carbonic oxide, ethylen, and propylen. Acetylen and carbonic acid are absent.

Transformation of the Bromated Hydrocarbides of the Ethylen Series into Bromides of the Acids of the Fatty Series by the Simple Addition of Oxygen.—E. Demole.—The author caused dry oxygen gas to react upon dibromated ethylen at an ordinary temperature. The addition product thus obtained is not dibromated oxide of ethylen, but bromide of bromacetyl.

Analysis of the Sulphurous Mineral Waters of Aix in Savoy and of Marlioz.—E. Willm.

Action of Oxygen upon the Anatomic Elements.—P. Bert.—The injurious influence of oxygen upon air-breathing vertebrates begins to be manifested at 5 or 6 atmospheres. The analysis of the gases contained in the blood shows that at this tension, the colouring-matter of the blood-globules being completely saturated with oxygen, this gas begins to dissolve in the plasma. If the duration of the compression is prolonged the solution of oxygen in the tissues becomes general, when a diminution of organic oxidation appears with its most immediate consequence, a fall of the temperature of the body.

Lactic Fermentation of Milk-Sugar.—Ch. Richet.—If milk is placed in a stove heated to 40° it becomes acid, coagulates, and after a time aquires an acidity of 1·6 of lactic acid in 100 parts of milk. This limit is never exceeded. If a few drops of a mineral acid are added to fresh milk the fermentation is completely checked and no further acidity is developed. But if, instead of a mineral acid, we add acid gastric juice the lactic fermentation is developed with extraordinary rapidity, and the milk reaches in four or five days an acidity equal to 4 per cent of lactic acid. The fermentation is arrested in presence of a large quantity of phenol, but unless there is sufficient of this reagent to remain in part undissolved in the liquid the fermentation is merely delayed

MISCELLANEOUS.

How History is Written!—The *Times* of the 21st inst. contains the following paragraph in its telegraphic letter from Paris:—"M. Lamy, the distinguished chemist, and discoverer of the metal thallium, died to-day."

The Chemical Society.—We have often inserted communications respecting the value of the Fellowship of the Chemical Society. For the sake of those who are interested in the question we insert the following extract from the *Chatham News* of February 17, 1878:—"Mr. W. Watson, Chemist, Rochester, has had a great honour conferred upon him by being elected a Fellow of the Chemical Society—a degree that may be considered the highest to attain in chemistry. When Mr. Watson sees his name associated with those men of such eminence as Professors Redwood, Attfield, Tyndall, Richardson, Abel, &c., we should say he must feel proud of the distinction. We believe there are but ten in Kent who have obtained the degree of F.C.S.

Russian Scientific News.—M. D. Latchinoff has tried some experiments with the telephone. He measured the resistance of coils and the magnetic moments of five instruments:—

	No. of Telephone.				
	1.	2.	3.	4.	5.
Resistance (Siemens units) ..	34	42	24	55	45
Position of the magnetic needle	45°	58°	51°	34°	45°

M. Latchinoff thinks that the vibrations of the plate in telephones has a different character from the vibrations producing Chladni's figures. The introduction of a feeble current into the telephone coil has no apparent action on the sound.

M. Slouginoff, in using during the electrolysis of H_2SO_4 an aluminium plate for anode, remarked the formation of a solid precipitate of alumina on the surface of the plate. The precipitate is remarkably solid, will scratch glass, and cannot be rubbed off even by emery powder. Alkalies and acids have a very feeble action on it. On a polished aluminium plate the alumina galvanically precipitated gives beautiful Nobili's rings.

M. N. Lubavin has examined the compounds of lactic nouclein. It appears that this substance is not the phosphoric salt of casein, but only contains a certain compound of phosphoric acid. Nouclein has the properties of a feeble acid. Its lead salt is especially remarkable, being a very constant compound; this salt contains for two equivalents of phosphorus always three equivalents of lead, even when it was obtained from differently prepared nouclein.

M. Barsilowsky has prepared meta-azotoluol in the form of orange crystals (melting-point 54°).

SERGIUS KERN.

St. Petersburg.

NOTES AND QUERIES.

Filling for Millstones.—In looking over a paper devoted to the milling interest I notice a letter from one of its correspondents referring to a note which appeared in a previous issue on "Lead Poisoning from Millstones." This correspondent states that he never uses lead for fixing cross-bars in millstones, knowing it to be poisonous. He recommends alum to be used, as he "has never known it to get loose." Some years ago, through the medium of your valuable journal, I drew attention to the practice of millers filling up the fractures, &c., in the millstones with a composition of alum and plaster of Paris; these were melted together and run whilst hot into the cracks in the stones; the individual above named "melts the alum and runs it into the stone the same way as lead." He knows that lead is poisonous, but he does not say what he knows of alum when it is introduced into the system. Does not the above give food for reflection.—J. H. SWINDELLS.

Falsification of "Scotch Soda."—A short time ago I had brought under my notice a quantity of crystals sold to oil-shops, &c., as Scotch washing-soda. They proved to be sulphate of soda with a *little variation*, and it may interest some of your readers to know that a considerable quantity of these crystals are being made and disposed of in London. I know four makers who are turning out upwards of

50 tons per week of this article, the whole of which is sold and consumed in London. The method of making this so-called Scotch or "Bastard" soda is as follows. Salt-cake or nitre-cake, &c., is dissolved in water until it has a specific gravity of 1·250, and the acid neutralised with milk of lime so that it will not act upon litmus paper; then, for every 100 lbs. of whatever cake is used 15 lbs. of soda-ash is dissolved in as small a quantity of water as possible—say to 1·350 sp. gr. or 70° T.—and, added to the other liquor, the whole is then well boiled up, allowed to settle, and run into iron pans, which must be clean and free from rust of iron. After crystallisation has finished, the mother-liquor is drawn off, and the crystals, a solid and compact mass, removed, broken up, and allowed to drain well, and then packed in casks for the market.—J. H. Swindells.

MEETINGS FOR THE WEEK.

Monday, 25th.—Medical, 8.30.
—— London Institution, 5.
—— Royal Geographical, 8.30.
—— Society of Arts, 8. "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," T. Bolas, F.C.S.

Tuesday 26th.—Civil Engineers, 8.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
—— Anthropological, 8.

Wednesday, 27th.—Society of Arts, 8. "State Aid to Music at Home and Abroad," Mr. Alan S. Cole.

Thursday, 28th.—Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
—— London Institution, 7.
—— Society of Arts, 8. (Chemical Section). "Electric Lighting," Dr. Paget Higgs.

Friday 29th.—Royal Institution, 8. Weekly Meeting. "Chemical Actions of Light, and their Electrical Relations," Prof. Dewar, 9.
—— Society of Arts, 8. (Indian Section). "The Depreciation of the Value of Silver, with essecial reference to the Exchange between India and England, and Suggestions for a Remedy," Col. J. T. Smith, R.E.

Saturday, 30th.—Royal Institution, 3. "Gleanings from the Natural History of the Ancients," Rev. W. Houghton.
—— Chemical, 8. (Anniversary).
Physical, 3. "Byrne's Pneumatic Battery," Mr. W. H. Preece.

Erratum.—P. 98, col. 2, line 8 from top, *for* "by the addition or abstraction of oxygen," *read* "by the action of oxidising on reducing agents."

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 22, Albemarle Street, W.—The NEXT ANNUAL GENERAL MEETING will be held at DUBLIN, commencing on WEDESDAY, August 14.

President-Elect.
W. SPOTTISWOODE, Esq., LL.D., F.R.S., F.R.A.S., F.R.G.S.

NOTICE to CONTRIBUTORS of MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several Communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section ....." If it should be inconvenient to the Author that his Paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M.A.,
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GEOLOGY.—In the Preface to the Student's ELEMENTS of GEOLOGY, by Sir Charles Lyall, price 9s., he says:—"As it is impossible to enable the reader to recognise rocks and minerals at sight by aid of verbal descriptions or figures, he will do well to obtain a well-arranged collection of specimens, such as may be procured from Mr. TENNANT (149, Strand), Teacher of Mineralogy at King's College, London." These Collections are supplied on the following terms, in plain Mahogany Cabinets:—

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 957.

ON THE COMPOSITION OF THE VITRIOL RUNNING FROM ABSORBING AND DENITRATING TOWERS.

By GEORGE E. DAVIS.*

In my former paper I pointed out that the estimation of the nitrous compounds in nitrosulphuric acid could not be effected in most instances by means of an oxidising agent, owing to the presence of other reducing substances than nitrogen oxides; but I also showed that the numbers obtained by permanganate from Gay-Lussac acid were nearly identical (when calculated as nitrous anhydride) with those obtained by reduction with mercury and subsequent measurement of the gas.

This, however, is not the case with the acids running from the denitrating column—the nitrogen oxides are nearly always totally abstracted, yet the permanganate often shows 2 grms. per litre, if the reduction of the standard oxidant is calculated to nitrous anhydride.

I have made many experiments upon this subject during the past few years; but the subject is fraught with more than ordinary difficulty, owing to the presence of arsenic and arsenious compounds, organic matter, ferrous sulphate, &c., and also to the fact that the nitrogen compounds themselves are not always all in the same state of oxidation.

The permanganate values corresponding to the mercury values led me to the conclusion that in Gay-Lussac acid the whole of the arsenic was present as arsenic acid, and the following experiments upon the same sample of acid put this beyond doubt.

It was at first thought possible to estimate the arsenic present as arsenic acid, by eliminating most of the sulphuric acid by barium hydrate, rendering alkaline and precipitating with magnesia mixture; but after many discordant results had been obtained it was found that the precipitated sulphate of baryta always contained arsenic.

It was next thought to neutralise with caustic potash removing the sparingly soluble sulphate; but although this was not open to the objection urged against the baryta, it was found that there existed in most vitriols, enough sulphate of alumina to carry down upon neutralisation a large quantity of the arsenic as arseniate of alumina.

Ten c.c. of the acid were rendered alkaline with ammonia and boiled; the precipitated arseniate of alumina was collected, dissolved in sulphuric acid, reduced with sulphur dioxide, and precipitated with hydrogen sulphide, the arsenious sulphide was oxidised with nitric acid (sp. gr. 1·50), precipitated with magnesia mixture, and weighed as magnesium pyro-arseniate. The results were as follows:—

Arsenic calculated as As_2O_5, grms. per litre.

1. 4·79	2. 4·66

In another series of experiments, sulphate of alumina was added and then excess of ammonia; the arseniate of alumina, when treated as above, gave the following results calculated as As_2O_5 in grms. per litre:—

1. 7·64	3. 7·55
2. 7·49	4. 7·48

In another series of experiments the vitriol was diluted with water, reduced with sulphur dioxide, and the arsenic thrown down as sulphide, which was oxidised and weighed as magnesium pyro-arseniate. Four expts. gave numbers as follows:—

1. 7·73	3. 7·60
2. 7·68	4. 7·72

Of course these experiments did not prove that the whole of the arsenic was present as arsenic acid; therefore Reicker's process was followed for the separation of arsenious and arsenic acids, viz., by distilling with sodium chloride. The distillate on being examined for arsenic contained traces only; the residue was then treated with sulphur dioxide, and the arsenic thrown down as sulphide, being weighed as before as pyro-arseniate.

The results were, in grms. of As_2O_5 per litre,—

1. 7·58	3. 7·61
2. 7·53	4. 7·72

Mean of four expts. for total arsenic .. 7·68
" " " arsenic in residue .. 7·61

This was considered very good proof that the whole of the arsenic was present as arsenic acid, the more especially as Mayerhofer has stated that when arsenic acid is heated with hydrochloric acid, arsenic is found in the distillate.

If then the whole of the arsenic was present as arsenic acid, and the nitrogen compounds were eliminated, the acid, when diluted with water, should become coloured upon adding a few drops of permanganate solution, unless some other reducing bodies were present.

With this end in view 10 c.c. of the vitriol were diluted with 20 c.c. water, and 2 grms. ammonium sulphate added—the whole boiled again to 10 c.c. This was then diluted with water, previously coloured with permanganate, of which latter 6·4 c.c were required to produce the same tint. This experiment was repeated several times with the same result.

The same experiment was then tried by simple dilution with water and boiling, when the following c.c. of decinormal permanganate were required in 4 expts.

1. 6·7 c.c.	3. 6·8 c.c.
2. 6·9 c.c.	4. 6·8 c.c.

The conclusion was, therefore, arrived at, that there exists in ordinary nitro-sulphuric acid substances other than nitrogen or arsenic compounds, which decolourise permanganate solution, probably ferrous sulphate and organic matter.

10 c.c. of the vitriol when largely diluted consumed 53·3 c.c. of decinormal permanganate.

2 c.c. when shaken with mercury yielded 12 c.c. of nitric oxide.

Lunge has stated in CHEMICAL NEWS vol. xxxvi. p. 147), "It was positively proved that by the more usual plan of testing nitrous vitriol, nitric acid is generated in the process of dilution, according to the equation:—

$$3NOOH = 2NO + NO_2OH + H_2O."$$

This may be the case when pure hydrogen nitrite is diluted with water (but of this I have no positive proof); but have we hydrogen nitrite in nitrous vitriol? I say no. It exists as nitrous anhydride, and the vitriol possessing such a strong affinity for water does not allow the formation of such a weak hydrogen salt as hydrogen nitrite. The nitrous anhydride, by reason of the strong vitriol in which it is dissolved, dissolves in water as such, and Frémy has also observed, that in a large excess of water, nitrous anhydride dissolves without decomposition (Comp. *Rendus.*, ixx., 61.)

I considered this proved by experiments made in 1872, and I have made more expts. lately, as follows:—

When 10 c.c. of nitrous vitriol is introduced into the bottom of a large flask, containing, say, 500 c.c. of water, and the acid and water gradually allowed to mix, no gas can be seen liberated, and if the experiment is carefully performed, the atmosphere of the flask does not alter iodide of starch paper. To the flask now add some

* A paper read before the Faraday Club.

potassium iodide solution, when, after a slight agitation to mix the two solutions, a gas is found to be liberated in quantity, and which is nitric oxide.

The hydriodic acid reduces the N_2O_3 to N_2O_2, a small quantity of which remains in solution, the major part, however, escaping as a gas.

The inference I draw from the observations of the above experiments, is—that as nitric oxide is but very sparingly soluble in water, if this had been formed upon simple dilution with water, some of it would have escaped as gas, whereas, nitric oxide does not escape until iodide of potassium is added.

Now, if we look back to the experiments already quoted, we shall find that there were required 53·3 c.c. of total permanganate, and 6·4 c.c. after the nitrogen oxides had all been decomposed, and as all the arsenic was present as arsenic acid, the quantity of oxidising material required for the oxides of nitrogen would be :—

53·3 minus—6·4=46·9 c.c.

Now, 46·9+0·0019, the factor for N_2O_3, gives 8·911 grms. per litre of nitrous anhydride; but calculating the N_2O_3 from the actual nitric oxide measured (*i.e.* from the 12 c.c. liberated from the 2 c.c. vitriol), it becomes evident that there is a nitrogen oxide present, the factor for which is greater than 0·0019.

Now, supposing the three nitrogen oxides here concerned, are completely converted by decinormal permanganate into nitric acid, their factors will be :—

Nitrogen peroxide (N_2O_4)	0·0046
„ trioxide (N_2O_3)	0·0019
„ dioxide (N_2O_2)	0·0015

Therefore it will be seen that from the numbers obtained by experiment, it is possible, that each of these three oxides may be present together; but as we know that nitric oxide is almost insoluble in strong oil of vitriol, the acid can only become saturated with it, the rest escapes. The error caused by the presence of nitric oxide is scarcely appreciable; there only remain then the two elements—the factors for the trioxide and tetroxide.

The 12 c.c. of nitric oxide liberated from from the 2 c.c. of vitriol correspond to 10·23 grms. per litre of nitrous anhydride.

From this we find, that of the 46·9 c.c. of decinormal permanganate reduced by nitrogen compounds; 40·43 c.c. were consumed by nitrous anhydride, and 6·47 c.c. by nitrogen tetroxide, making the amounts of the various substances in grms. per litre as follows:—

Arsenic acid (As_2O_5)	7·61
Nitrogen tetroxide (N_2O_4)	2·97
" trioxide (N_2O_3)	7·68

Turning now from the Gay-Lussac acid to that running from the denitrating column, the arsenic is found in its two states of oxidation. Determining the amounts by Reicker's process, I found :—

	I.	II.
As_2O_3	6·14	7·23
As_2O_5	2·38	2·94

These were two distinct samples.

Now, when the denitrated acid is shaken up with mercury, the dissolved sulphur dioxide is often liberated; therefore I find it better to add a minute quantity of finely powdered permanganate of potash to the acid before measuring off the quantity for examination, as by shaking with mercury it may be liberated in the gaseous form, and mistaken for nitric oxide.

The sulphurous acid may be estimated by heating the vitriol in a tube, filled with beads, aspirating a current of dry carbonic acid, passing the liberated gas into peroxide of hydrogen, and weighing as barium sulphate. In this manner I have found, in grms. per litre of SO_2 in various samples :—

1. 0·11	3. 0·09
2. 0·08	4. 0·12

After oxidising the sulphur dioxide with permanganate, the nitrogen dioxide present may be estimated by shaking up with mercury—I usually employ 10 c.c. of the O.V. The nitric oxide seems to be mechanically mixed rather than in true solution, and the agitation simply liberates it. Six different samples of acid running from the denitrating column gave N_2O_2 as under :—

1. 0·13	4. 0·03
2. 0·00	5. 0·06
3. 0·02	6. 0·00

A sample of sp. gr. 1·75 running from the denitrating column, gave as follows :—

As_2O_3	6·26 Grms. per litre.
As_2O_5	1·98 „
SO_2	0·12 „
N_2O_2	0·04 „

This was the acid which, when run down, the absorbing column gave the acid already examined. We may compare them as follows :—

	Before going down absorber Grms. per litre.	After Grms. per litre.
As_2O_3	6·26	0
As_2O_5	1·98	7·61
N_2O_4	0	2·97
N_2O_3	0	7·68
N_2O_2	0·04	—
SO_2	0·12	0

From the foregoing experiments, we learn that the arsenic becomes peroxidised by running down the absorbing column, and again becomes deoxidised by running down the denitrating column.

Barton Arcade, Manchester.
Jan. 16, 1878.

POSSIBLE USE FOR A CONSTITUENT OF GAS-LIME.

By THOMAS DOUGLAS.

The following experiment was made some months since to find if the sulpho-cyanates, usually found in some quantity in gas-lime, could be readily transformed into ferro-cyanides. It is an established reaction that potassium sulpho-cyanate and iron-filings heated together yield potassium ferro-cyanide and the sulphides of potassium and iron. I wished to determine if a crude sulpho-cyanate extracted from gas-lime would give a ferro-cyanide with the same treatment.

Some gas-lime was mixed with about 5 per cent of soda-ash, extracted with water, and the solution evaporated to dryness. The dry extract was mixed with iron-filings in a mortar, then heated in a small covered clay crucible for a short time over a Bunsen lamp. The residue, boiled with water and acidified with hydrochloric acid, gave an abundant precipitate of Prussian blue with ferric chloride.

I have not time, and it is rather out of my way, to experiment further on this subject at present. It was called to mind by the report of Mr. Mayer's paper on "Hislop's Process for the Regeneration of Gas-Lime," in a recent issue of the Chemical News (vol. xxxvii., p. 89). If the above process for obtaining ferro-cyanides from gas-lime should prove of any commercial value it would be a ready method of getting rid of at least part of the sulphur compounds in gas-lime. Alkaline sulpho-cyanates are very soluble in water, and a strong solution would be obtained by passing the same liquor through successive fresh portions of gas-lime until saturated.

Whickham-on-Tyne

ANALYSES OF CANE AND BEET-ROOT SUGAR ASH.

By J. W. MACDONALD.

THE CHEMICAL NEWS, vol. xxxvii, p. 76, contains an analysis of Demerara sugar ash, by Dr. Wallace, which is very interesting. Perhaps the following may also be of interest, especially to those of your readers connected with Messrs. Duncan and Newland's alum process..

The samples were obtained by preserving the ashes of *all* cane and beet sugars, analysed in the laboratory of a large sugar refinery, during one year. The analyses may therefore be taken as representing the average composition as regards bases, phosphoric and carbonic anhydrides and chlorine having been displaced by the sulphuric acid employed in the sugar analyses.

It will be noticed that cane ash contains a larger proportion of lime, magnesia, ferric oxide, and sand than beet. These substances are removed from the juices in the beet manufactories, but in the West Indies and cane-producing countries the manufacture of sugar has not yet reached such a perfect state.

	Cane Ash.	Beet Ash.
Potash	28·79	34·19
Soda	0·87	11·12
Lime	8·83	3·60
Magnesia	2·73	0·16
Ferric oxide and alumina ..	6·90	0·28
Sulphuric anhydride	43·65	48·85
Sand and silica	8·29	1·78
	100·06	99·98

Love Lane Refinery, Liverpool.

ON THE

SULPHATES OF THE VANADIUM PENTOXIDE.

By Dr. B. W. GERLAND.

BERZELIUS has described two compounds of vanad-pentoxide with sulphur trioxide, $V_2O_5,3SO_3$ and $V_2O_5,2SO_3$, and mentioned in addition to these a mono-basic and a mono-acid sulphate, of which no composition is given.

Vanad-pentoxide is more or less soluble in sulphuric acid according to its preparation. The crystals formed by cooling the molten pentoxide require a long-continued digestion at an elevated temperature, whilst the crystalline powder obtained by roasting the ammonium vanadate dissolves readily. This salt is decomposed slowly but completely in a current of air at a temperature of 140° C., yielding a dark brown pentoxide, which, when mixed with sulphuric acid and a little water, enters into solution with evolution of heat. The higher the temperature to which the pentoxide is subjected the lighter are its colours, until towards 200° a light brick-red powder is obtained, and the more it resists the solvent action of sulphuric acid. The microscopic scales of the meta-vanadic acid, notwithstanding their thinness, require long digestion with sulphuric acid at an elevated temperature. The concentrated solutions, whether prepared hot or cold, are deep reddish brown, and solidify on cooling to a crystalline mass of the colour and appearance of ferric chloride: addition of water changes the colour successively to blood-red (like ferric acetate) olive-green, and pale yellow. These solutions are easily acted upon by reducing substances, and all the more so the higher their temperature and the more they are concentrated.

The Dialysis of the Solution of Vanad-pentoxide in Sulphuric Acid.—A solution of the pentoxide in an excess of sulphuric acid, which has been boiled or kept for some time, readily parts with the excess of the acid, leaving the compound $V_2O_5,3SO_3$. This compound, by continued exposure, loses sulphuric acid very slowly, and the composition approaches more and more that expressed by the formula $V_2O_5,2SO_3$.

(1.) A solution containing 1 grm. V_2O_5, and an excess of sulphuric acid measuring 10 c.c., was brought upon the dialyser with parchment-paper, and floated upon an equal volume of water: the latter was renewed five times in three days, when the remaining liquor was analysed :—

Found —
$PbSO_4$ .. 0·2503 grm. V_2O_5 .. 0·0502 grm.
Calculated—
SO_3 .. 0·0661 grm. V_2O_5 .. 0·0502 grm.

SO_3 and V_2O_5 are therefore in the proportion, 3 mols. SO_3 to 1 mol. V_2O_5.

(2.) A solution of the sulphate, prepared like the former, was placed in the dialyser, and floated on a larger volume of water, about ten-fold the quantity, which was changed seven times in ten days. The colour of the sulphate had passed from green to yellow, but no deposit was formed. The composition was found to be—

$PbSO_4$ .. 0·3775 grm. V_2O_5 .. 0·0993 grm.
Calculated—
SO_3 .. 0·0996 grm. V_2O_5 .. 0·0993 grm.

That is, $SO_3 : V_2O_5 = 2·29$ mol. : 1 mol.

In another experiment made under similar circumstances :—

(3.) The solution left in the dialyser yielded by analysis—

$PbSO_4$ .. 0·2109 grm. V_2O_5 .. 0·0537 grm.
Calculated—
SO_3 .. 0·0577 grm. V_2O_5 .. 0·0537 grm.

Or 2·36 mol. SO_3 to 1 mol. V_2O_5.

A solution recently prepared of the brown pentoxide, obtained by roasting ammonium vanadate at a low temperature, in cold dilute sulphuric acid behaves essentially differently on the dialyser. 20 grms. pentoxide dissolved in 45 grms. sulphuric acid, diluted to 300 c.c., were brought upon the dialyser, and placed on 400 c.c. water. The solution soon became blood-red, like ferric acetate; and on the third day, after two changes of the outer water, large deposit of brown vanadic acid had formed upon the membrane, and a smaller one in the outer water. The deep red colour of the solution changes to green on the addition of sulphuric acid.

10 grms. of the clear red solution from the dialyser yielded—

$PbSO_4$ .. 0·7642 grm. V_2O_5 .. 0·2532 grm.
Calculated—
SO_3 .. 0·2017 grm. V_2O_5 .. 0·2532 grm.

Or 1·81 mol. SO_3 to 1 mol. V_2O_5.

The filtered liquor, left to itself, continues to deposit vanadic acid, and thereby changes its colour from deep red to yellow and green. After five days' standing it was submitted to analysis.

20 c.c. yielded—

$PbSO_4$ .. 1·5297 grm. V_2O_5 .. 0·2610 grm.
Calculated—
SO_3 .. 0·4039 grm. V_2O_5 .. 0·2610 grm.

Or 3·53 mol. SO_3 to 1 mol. V_2O_5.

20 c.c. of the same solution, taken seven days later, yielded—

$PbSO_4$ .. 1·5157 grm. V_2O_5 .. 0·2687 grm.
Calculated—
SO_3 .. 0·4008 grm. V_2O_5 .. 0·2687 grm.

Or 3·43 mol. SO_3 to 1 mol. V_2O_5.

It therefore appears that during the last seven days a portion of the vanadic acid was re-dissolved.

Another solution, prepared by dissolving the brown pentoxide in cold sulphuric acid, was subjected to dialysis in the apparatus, and upon the same membrane used in the above-described experiment, which yielded the compound $V_2O_5,3SO_3$ from boiled solution of pentoxide in an excess of sulphuric acid after five renewals of the water. The solution underwent the same changes as in the last

trial; it was analysed when the colour was deep red, and a deposit of vanadic acid formed. Found—

$PbSO_4$.. 0·1074 grm. V_2O_5.. 0·0487 grm.

Calculated—

SO_3 .. 0·02835 grm. V_2O_5.. 0·0487 grm.

Or 1·32 mol. SO_3 to 1 mol. V_2O_5.

These results leave no doubt that a difference exists in the constitution of the solutions of vanad-pentoxide in sulphuric acid prepared in the cold, and the same solution after heating (and probably after the lapse of time): the former contains a molecular compound, which is converted by boiling into the atomistic compound, $V_2O_23SO_4$, *Vanadylic Sulphate*. Nevertheless, both solutions possess the same colour, and this undergoes the same changes by dilution with water. It would be interesting to examine into the thermic relations of these compounds, only want of convenience prevented me from investigating this remarkable behaviour in that direction.

Vanadylic Sulphate, $V_2O_23SO_4$.—This compound is obtained (according to Berzelius) by evaporating the solution of vanad-pentoxide in an excess of diluted sulphuric acid and expelling the latter at a low temperature. The concentrated solution was exposed in an air-bath to a temperature of 200°. Clouds of sulphuric acid escaped, and when these decreased the heating was interrupted. A hard crystalline red substance was left: this absorbed moisture rapidly, and formed a dark brown solution, but on the addition of water it was at once decomposed with the separation of vanadic acid. The solid residue was superficially tinged green by the insoluble vanadylous sulphate, $V_2O_22SO_4$, owing to the fire-gases having found access, but otherwise it was of a bright brick-red colour and crystalline texture. For analysis the weighed sample was treated with highly dilute nitric acid in the cold, whereby the vanadylic sulphate is dissolved without separation of vanadic acid, and the vanadylous sulphate is left intact.

(1.) Sample from the interior. Found, per cent—

$V_2O_2,2SO_4$.. 1·38 $PbSO_4$.. 188·58 V_2O_5.. 47·49

(2.) Sample from the exterior. Found, per cent—

$V_2O_2,2SO_4$.. 15·19 $PbSO_4$.. 161·60 V_2O_5.. 43·35

Calculated—

	I.	II.
$V_2O_2,2SO_4$ ..	1·38	15·19
V_2O_5	47·49—1 mol.	43·35—1 mol.
SO_3	49·46—2·38 mol.	42·66—2·25 mol.
	98·33	101·20

The neutral sulphate, $V_2O_23SO_4$, therefore suffers a gradual decomposition by the temperature of 200°; the substance left in the experiment is a mixture of neutral sulphate and basic sulphate, $V_2O_2,O,2SO_4$.

A concentrated solution of vanad-pentoxide in a large excess of sulphuric acid, when rapidly boiled, deposits small crystals, which are sometimes of an opaque brown, and sometimes of a splendid ruby colour, transparent, of great lustre, and apparently regular octahedrons. If the boiling is interrupted soon after the first appearance of these crystals, fine needle-shaped crystals of golden colour separate on cooling. All these different forms seem to have the same composition. The experiment requires the utmost attention, as the boiling becomes very violent as soon as the compound separates, and is managed only with difficulty owing to the high temperature and the mass of escaping sulphuric acid. The sulphate is easily deoxidised at that temperature by dust, and even by the fire-gases, and their exclusion is a matter with which I have only been successful in very few cases. Addition of perchloric acid counteracts these reducing agents to some extent; the same is decomposed by acid solutions of the tetroxide. The crystals while still hot were thrown on a Bunsen filter, and as quickly as possible placed between well dried porous tiles, and left under a bell dipping in vitriol. These crystals absorb moisture with avidity; with cold water or alcohol they form clear solutions, which, when heated, deposit brown vanadic acid, retaining some sulphuric acid. The analyses of different preparations gave the following results:—

		Insoluble $V_2O_2,2SO_4$.	$PbSO_4$.	V_2O_5.
		Grm.	Grm.	Grm.
(1.)	0·9867 grm. substance yielded	—	2·0677	0·3412
(2.)	1·0433 „ „	0·0570	2·1344	0·3880
(3.)	0·8529 „ „	0·0776	1·6422	0·2950
(4.)	1·0979 „ „	0·0863	2·1602	0·4140
(5.)	0·7967 „ „	—	1·7554	0·2709
	0·6790 „ H_2O, 0·0597			
(6.)	0·6679 „ yielded	0·0775	1·1890	0·2716
(7.)	0·7657 „ „	—	1·5633	0·2970
(8.)	0·6248 „ „	—	1·2653	0·2680

Calculated for—

	(1.) p.c.	(2.) p.c.	(3.) p.c.	(4.) p.c.	(5.) p.c.	(6.) p.c.	(7.) p.c.	(8.) p.c.
$V_2O_2,2SO_4$ ..	—	5·46	9·10	7·86	—	11·60	—	—
V_2O_5	34·58	37·19	34·58	37·71	34·00	40·66	38·79	42·89
SO_3	52·69	54·01	50·83	51·95	58·17	47·00	53·90	53·47
H_2O					8·77			
					100·49			

It was not to be expected that the analyses of a subtance so hygroscopic as this, and so difficult to prepare and purify, should give satisfactory results; still if the above figures do not absolutely prove, they at least make it most probable, that the pure compound is anhydrous, and is to be expressed by the formula $V_2O_23SO_4$. With this formula the analyses (2.). (4.), (6.), (7.), agree best. For the sake of comparison they are re-calculated after deduction of the accidental vanadylous sulphate, and placed beside the composition corresponding to the formula $V_2O_23SO_4$

	Found. (2.)	(4.)	(6.)	(7.)	Calculated for $V_2O_23SO_4$.
V_2O_5	39·4	40·9	46·0	38·8	43·2
SO_3	57·1	56·4	53·2	53·9	56·8
H_2O (difference)	3·5	2·7	0·8	7·3	—
	100·0	100·0	100·0	100·0	100·0

The acid solution, from which these crystals have separated, is of a light brown colour, and retains only a small amount of vanad-pentoxide, as the following analysis demonstrated:—

1·584 grm. of the acid solution separated from the crystals yielded—

$PbSO_4$.. 4·7976 grms. V_2O_5.. 0·0330 grm.

Calculated—

V_2O_5	2·08
SO_3..	79·89
H_2O (difference)	18·03
	100·00

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 22, 1878.

Dr. J. H. Gladstone, F.R.S., President, in the Chair

After the announcement of visitors, &c., the following certificates were read for the first time:—G. A. George, W. Jago, H. W. Jones, and J. W. Knights.

The President then announced that Mr. E. Neison having proposed Mr. C. T. Kingzett as a member of the Council, the name of the latter gentleman would be suspended along with the list of names recommended by the Council.

The first paper was read by Dr. OTTO N. WITT, "*On Aromatic Nitrosamines.*" In 1874 the author made some experiments on the action of nitrous acid, and especially its ethers, on secondary and tertiary amines: the facts observed were communicated to the Chemical Societies of Zurich and Berlin. In his inaugural dissertation (1875) the author gave a detailed account of the formation and properties of diphenyl-nitrosamine. Since that time a more careful study of some complicated reactions of diphenyl-nitrosamine has been made, and the results of these investigations the author gives in the following paper:—Whenever a secondary amine is acted upon by nitrous acid water is given off, and a nitrosamine (*i.e.*, a substituted ammonia which contains instead of at least one hydrogen, the mono-valent group NO in immediate connection with the ammoniacal nitrogen) is formed. Thus—

$$\begin{matrix} C_2H_5 \\ | \\ NH \\ | \\ C_2H_5 \end{matrix} + HONO = H_2O + \begin{cases} C_2H_5 \\ | \\ N—NO. \\ | \\ C_2H_5 \end{cases}$$

Diethyl-amine. Diethyl-nitrosamine.

Similarly, by the action ot ethylic nitrite, amylic nitrite, or nitrous vapours on diphenylamine, diphenyl-nitrosamine is formed. This latter substance crystallises readily in large, honey-coloured, monoclinic crystals, melting at 66·5° C., soluble in alcohol, benzol, &c. It dissolves readily in concentrated sulphuric acid with a beautiful blue colour, large quantities of nitric oxide being evolved. Powerful reducing agents split off ammonia, and reproduce diphenylamine. The action of aniline and the primary monamines on diphenyl-nitrosamine is violent, diphenylamine being regenerated, with the formation of diazobenzol, the latter forming successively diazo-amidobenzol and amido-azobenzol. Under certain circumstances a secondary reaction takes place, a substance, $C_{36}H_{29}N_5$, being formed, which, when treated with sulphuric acid, gives a blue colouring matter with a crimson fluorescence and a spectrum of three dark bands. If ordinary ethylic nitrite—obtained by passing nitrous vapours into alcohol—be used, a mixture of products is formed, in the investigation of which the author encountered many difficulties. When burnt in a combustion-tube these bodies gave off rapidly large quantities of nitrous vapours, whilst a very dense charcoal was left behind, which was difficult to burn completely. On investigation the author found that the substance commonly called anhydric nitrous acid (prepared by the action of nitric acid on starch, &c.) is really N_2O_4, and splits up by contact with alcohol or water into nitric and nitrous acids. Thus ordinary ethylic nitrite always contains nitric acid. The author therefore used mixtures of pure amylic nitrite and nitric acid; acting with these on known weights of diphenylamine, and moderating or accelerating the reactions by the use of various solvents, he has obtained mono-nitro-diphenyl-nitrosamine and two bodies which, on the removal of their nitroso-groups, yielded dinitrodiphenylamine, and an isomer. Mono-nitro-diphenyl-nitrosamine.—To 20 grms. of diphenylamine, finely powdered, a mixture of 15 c.c. nitric acid, 35 grms. pure amyiic nitrite, and 100 c.c. of methylated alcohol is added. On shaking—and, if necessary, heating—crystals separate. The liquid is now cooled by ice, when a crystalline deposit is obtained, which is filtered off, washed with spirit, dried, and re-crystallised from chloroform. This substance forms light yellow plates, melting at 133·5° C., soluble in benzol, hot alcohol, and glacial acetic acid. When treated with strong sulphuric acid it gives off nitric oxide, the liquid becoming purple. By the action of aniline or alcoholic potash mono-nitro-diphenylamine was obtained in pale yellow glistening scales, melting at 132° C. It does not colour sulphuric acid, but dissolves in alcoholic potash with a fine red colour. By the action of bromine on mono-nitro-diphenyl-nitrosamine dissolved in glacial acetic acid two products were obtained—one in canary-yellow coloured silky needles fusing at 208·5° to 209°; the second in heavy, well-shaped, small prisms, melting at 214·5° to 215°. If instead of the quantities given above the following be used—17 grms. diphenylamine, 50 c.c. glacial acetic acid, 40 c.c. nitric acid, 50 c.c. methylated spirit, and 48 grms. nitrite of amyl—a light yellow sandy powder is obtained, which dissolves in sulphuric acid with a dirty violet colour, nitric oxide being given off. The analyses seemed to indicate a formula intermediate between di- and trinitro-diphenyl-nitrosamine. The author therefore acted on the substance with aniline, and alcoholic potash, precipitating the resulting liquid with dilute hydrochloric acid. By treating this precipitate with alcohol a solution was obtained, which furnished long, thick pointed, dark yellow needles, fusing at 214°, and dissolving in alcoholic potash with a bright purple colour. Analysis proved this substance to be dinitrodiphenylamine. The residue insoluble in alcohol was recrystallised from xylene, and obtained in granular vermilion crystals fusing at 211·5°, which dissolve in alcoholic potash with a scarlet colour. Analysis proved this substance to be isomeric with the last. All the above substances, when treated with strong nitric acid, yield hexa-nitro-diphenylamine. The author points out that the method of nitration above described will probably be found applicable in many cases where nitration has hitherto offered unusual difficulties, and also lends some support to the theory that the formation of nitroso-compounds always precedes the introduction of the nitro-group into the molecule of aromatic substances. The author mentions in conclusion that Mr. Meldola communicated to the CHEMICAL NEWS (Feb. 8, 1878) a note on a new colouring matter. On examination this new dye-stuff, "Citronin," turned out to be a mixture of mono- and dinitro-diphenylamines. Mr. Meldoia, on learning that the author had been engaged with these bodies for some years, relinquished the investigation. For this act of courtesy the author thanks Mr. Meldola, but wishes to state that the merit of the practical application of this substance as a dyestuff belongs solely and entirely to that chemist. The author promised a second paper in continuation of the research, and stated that but for the incident just referred to he should not have published his researches at so early a date.

Mr. MELDOLA said that Dr. Witt had given a perfectly correct statement of the case as far as he was concerned. At the time he first obtained citronin he was aware that Dr. Witt had been working at the subject, and therefore thought that he was the proper person to communicate with. His communication, he ventured to think, considering the interesting paper they had just heard, had been attended with the happiest results as regards the Society and himself.

Mr. GROVES remarked that when phenol is acted upon by dilute nitric acid a small quantity of nitroso compounds seems to be first formed; also in the formation of trinitro-orcin, nitroso compounds seemed to be at first produced, thus confirming the statement of Dr. Witt.

Dr. ARMSTRONG thought that although in many cases we had evidence of the pre-formation of nitroso compounds, yet it probably was not always the case. Thus some of the sulpho-acids of phenol nitrate with very great readiness without any indication of nitroso compounds being formed.

After a short discussion between Drs. Armstrong and Witt as to the constitution of the bodies mentioned in the above paper,

The PRESIDENT gave the best thanks of the Society to Dr. Witt for his interesting paper, which was illustrated by experiments and the exhibition of specimens of the above beautifully crystallised substances.

The next paper was read by Dr. ARMSTRONG, and was entitled "*On a New Process for the Volumetric Estimation of Cyanides*, by J. B. HANNAY. The cyanide is dissolved in water, and the solution is rendered alkaline by ammonia. A half-strength decinormal solution of mercuric

chloride is run in with constant stirring. At first the reaction $2KCN+HgCl_2=Hg(CN)_2+2KCl$ takes place, but as soon as all the cyanide has been thus decomposed the slightest trace of mercuric chloride renders the liquid distinctly opalescent. The end reaction is sharply marked and very delicate. Many experiments were performed as to the action of alkaline sulphates, chlorides, and nitrates. The results were similar to those already obtained by Tuson and Neison (*Chem. Soc. Journ.*, 1877, ii., 679). Very large quantities of ammonium salts prevent the appearance of the opalescence. Cyanates and sulphocyanides do not interfere. The presence of silver salts does not hinder the reaction. The author, therefore, recommends the process as one of great facility.

The next paper was read by Mr. M. M. P. MUIR, "*On Certain Bismuth Compounds* (*Part* VII.)." In the first portion of this paper the author details reactions illustrating some points of contrast between bismuthous and phosphorous chlorides. The latter substance is oxidised with comparative ease, and therefore acts as a reducing agent in certain reactions: the former undergoes only incomplete oxidation, and therefore exerts no action in such cases. The two oxalates of bismuth, $Bi_2C_2O_4.6H_2O$, and $Bi_2C_4O_8$, are then studied. Experiments on the production of some so-called bismuthates are next detailed. The author inclines to the hypothesis that the higher oxides of bismuth exhibit exceedingly feeble acid characters. The paper concludes with the description of some experiments on bismuthous iodide. The oxidation of this compound by air when in a fused state is compared with the behaviour of the corresponding chloride and bromide under similar conditions: the iodide oxidises much more slowly than either the chloride or bromide. Bismuthous iodide prepared in the wet way is more readily decomposed by water than the same salt prepared in the dry way.

The thanks of the Society were given to the author, who exhibited an interesting series of bismuth compounds.

Mr. WILLIAMS then exhibited a splendid sample of salicylic acid, about 24 ounces, prepared from the oil of winter-green, the natural product crystallising apparently better than the artificially prepared acid; also about 1 gallon of pure methylic alcohol.

Dr. WITT, in answer to Mr. Maxwell Lyte, said that the "vinasses," formerly a waste-product of the beet-root sugar manufacture, had lately been utilised under a patent for the production of methylic chloride, which was largely used by the aniline colour manufacturers. The gas was prepared, washed, and pumped into metal reservoirs, containing 25 kilogrms. each; the patentee, Brigonnet, making as much as 1000 kilos. a day.

The Society then adjourned to April 4 (Anniversary Meeting, Saturday, March 30), when a lecture "On the Application of the Microscope to some Special Branches of Chemistry," will be delivered by H. C. Sorby, F.R.S.

EDINBURGH UNIVERSITY CHEMICAL SOCIETY.

Seventh Meeting, March 13, 1878.

W. INGLIS CLARK, B.Sc., in the Chair.

A PAPER was read by Mr. ADRIAN BLAIKIE on the "*Salts of Trimethyl-sulphine*," containing the results of an investigation carried on by Professor CRUM BROWN and the author.

The hydrate of trimethyl-sulphine obtained by acting on the iodide of trimethyl-sulphine with moist oxide of silver in concentrated solution rapidly absorbs sulphuretted hydrogen, forming a sulphydrate of trimethyl-sulphine—

$$(CH_3)_3S.OH+H_2S=(CH_3)_3S.SH+H_2O.$$

The strong solution of this hydrate has all the reactions of an alkaline sulphydrate, and when evaporated oxidises slowly to the hyposulphite of trimethyl-sulphine.

The sulphide of trimethyl-sulphine is obtained by mixing equal quantities of solutions of oxyhydrate and sulphydrate of trimethyl-sulphine,

$$(CH_3)_3S.OH+(CH_3)_3S.SH=[(CH_3)_3S]_2S+H_2O.$$

The aqueous solution, when evaporated over phosphoric anhydride in an atmosphere of coal-gas, does not crystallise out, but after a certain strength of solution has been reached begins to decompose into sulphide of methyl,

$$[(CH_3)_3S]_2S=3(CH_3)_2S,$$

which, when the solution is contained in a sealed tube, separates out, forming a layer of sulphide of methyl above the aqueous solution. This solution has, however, all the characteristics of an alkaline sulphide. It dissolves sulphide of antimony, gives the reaction with sodic-nitroprusside, and with hydrochloric acid gives off sulphuretted hydrogen, leaving the chloride of trimethyl-sulphine, easily recognised by mercuric chloride, when the double salt crystallises out. When exposed to the air the sulphide of trimethyl-sulphine is rapidly oxidised to the hyposulphite.

The hyposulphite of trimethyl-sulphine is best obtained by oxidation of the polysulphide obtained by dissolving sulphur in the sulphide.

$$[(CH_3)_3S]_2S+4S=[(CH_3)_3S]_2S_5.$$

By exposing the polysulphide to the air for a few days the sulphur crystallises out, and the hyposulphite is left in solution, and by careful evaporation is obtained in clear four-sided prisms, with one molecule of water of crystallisation.

$$[(CH_3)_3S]_2S_5+3O=[(CH_3)_3S]_2S_2O_3+3S.$$

The following are results of analysis:—

I. 0·1192 grm. substance gave—
0·0745 grm. H_2O = 0·1086 grm. CO_2.

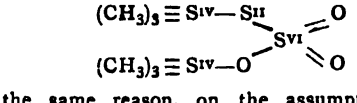
II. 0·2299 grm. substance gave—
0·1402 grm. H_2O = 0·2056 grm. CO_2.

III. 0·2600 grm. substance gave—
0·8459 grm. $BaSO_4$ = 0·1169 grm. S.

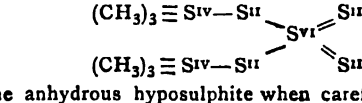
	Found. I.	Found. II.	Found. III.	Calculated for $[(CH_3)_3S]_2S_2O_3+H_2O$.
C ..	24·85	24·64	—	25·35
H ..	6·94	7·06	—	7·04
S ..	—	—	44·65	45·07

The salt is very hydroscopic, sparingly soluble in alcohol, and gives all the reactions of an alkaline hyposulphite. Over phosphoric anhydride the water of crystallisation is given off. 7·261 grms. of the salt lost 6·37 per cent water, which is present in the crystallised salt to the extent of 6·33 per cent.

This compound is interesting from a theoretical point of view, since the constitutional formula may be represented with dyad, tetrad, and hexad sulphur atoms in one molecule.



For the same reason, on the assumption that the polysulphide is a sulphate in which all the oxygen atoms are replaced by sulphur, and also because in it, on this assumption, we may have *seven* atoms of sulphur directly grouped together, is the polysulphide of trimethyl-sulphine, from which the hyposulphite is obtained.



The anhydrous hyposulphite when carefully heated to 135° C. gives off sulphide of methyl. 5·545 grms. gave off when heated 23·58 per cent sulphide of methyl, leaving on cooling a white crystalline mass, soluble in water, alcohol, and ether, and very hydroscopic. The quantity of sulphide of methyl given off points to a methyl-hyposulphite of trimethyl-sulphine, since, if the hyposulphite

gave off 23·30 per cent sulphide of methyl, we should expect a substance having that composition.

$$[(CH_3)_3S]_2S_2O_3—S(CH_3)_2=\begin{matrix}CH_3\\(CH_3)_3S\end{matrix}\!\!>S_2O_3.$$

This product of decomposition is at present under investigation; by further heating at 140° sulphurous acid gas is evolved.

The oxalate of trimethyl-sulphine is obtained by acting on the iodide with oxalate of silver, and can be obtained in clear hydroscopic plates with one molecule water of crystallisation. The following are the results of analysis:—

I. 0·1526 grm. substance gave—
0·1082 grm. H_2O = 0·2068 grm. CO_2.
I. 0·1823 grm. substance gave—
0·1296 grm. H_2O = 0·2489 grm. CO_2.

	Found. I.	Found. II.	Calculated for $\begin{matrix}COO—S(CH_3)_2\\COO—S(CH_3)_2\end{matrix}+H_2O$.
C ..	36·95	36·78	36·92
H ..	7·87	7·89	7·69

On carefully heating the salt at 110° C. the water of crystallisation is given off, and at 140° C. sulphide of methyl, leaving pure oxalate of methyl, which crystallised out, and was recognised by its melting-point, 51° C., and its boiling-point, 157° C.

$$[(CH_3)_3S]_2(OOC)_2+H_2O=$$
$$=(CH_3)_2(OOC)_2+2S(CH_3)_2+H_2O.$$

The chromate and iodate of trimethyl-sulphine can both be prepared by means of the silver salts from the iodide. Both these salts, on heating to about 140° C., melt, but immediately afterwards explode, the former leaving green oxide of chromium.

The further decomposition of the hyposulphite of trimethyl-sulphine and of various other salts is under investigation.

A paper was also read by Mr. JOHN TREHARNE, M.B., C.M., "*On the Cooling of Fats.*" If equal bulks of the fats of mutton, beef, pork, and butter, and palm oil be heated to 100° C. in a small flask fitted with a thermometer through the cork, and are then allowed to cool by radiation under the same conditions for each, the temperature is found to fall regularly to a certain point (which is different for each of the fats above named), and then to rise to a certain turning-point. These turning-points are approximately as follows:—

For mutton fat	40·0° C.
„ beef „	28·5 „
„ pork „	26·5 „
„ butter „	23·5 „
„ palm oil	21·0 „

The extent of the rise in temperature is different in each fat; being greatest in that of mutton, and least in that of butter and palm oil. The extent of the rise is also greater within certain limits the greater the quantity of fat employed; but, as a rule, the turning-point is pretty constant for the same fat. There is also a little difference in the turning-point and the extent of rise according to the part of the carcase from which the fat has been taken.

If temperature and time be taken as co-ordinates and the rate of cooling be represented by curves these latter will be characteristic of the respective fats. A mixture of equal parts of mutton and butter fats does not give a curve intermediate between those of its components, but is such as to indicate that less heat is given out in cooling (to 20° C. say) than in the case of butter, which, compared with mutton fat gives off very little heat.

Preparation of Methyl Allyl.—H. Grosheintz.—The author heats to 135° in an autoclave, a mixture of 40 parts zinc-methyl, 120 iodide of allyl, and 100 of an alloy of zinc and sodium at 3 per cent.—*Bulletin de la Societe Chimique de Paris.*

CORRESPONDENCE.

CHEMISTS AND CHEMISTS.

To the Editor of the Chemical News.

SIR,—I have asserted that of the two classes of chemists who now gain their living as chemists, the "Chemist and Druggist" is just able to say that he reckons his age by hundreds of years, while his namesake, better chemist though he be, only reckons his by tens; for, while some of the substances we term chemicals have been known for centuries, the age of chemistry as a science can still be written with two figures. "A Credulous Chemist" asks me for dates and references to satisfy doubters of the distinctive priority of "the druggist's" claim. I do not generally reply to anonymous correspondents, but as in response to my request he has given me abundant evidence that his credulity and his friendship are of as satisfactory a nature as I could possibly desire, I most gladly comply with his suggestions.

1493 to 1541.—Paracelsus, says Rodwell in his "Birth of Chemistry," helped to withdraw men from the pursuit of alchemy by asserting that the knowledge of the composition of bodies, which had necessarily been forwarded by alchemy, was of importance to the human race for the better prevention and curing of their ills. Butler, in his "Historical Introduction to Chemistry," in the ninth edition of the "Encylopædia Britannica," remarks that it was in the 16th century that a new race of alchemists, or spagyrists, as they were termed, arose, who, abandoning the search for the philosopher's stone, began to direct their energies to the discovery of chemical remedies for the various diseases of the body; and quotes the following words of Paracelsus:—"The true use of chemistry is not to make gold but to prepare medicines."

1653.—That alchemy did thus develop into what we should now term pharmaceutical chemistry is clear from the character of the first great text-book of chemistry published, which I shall notice in due chronological order; but even within little more than a century from the death of Paracelsus, it was possible to divide Materia Medica into "Chymical Medecins" and Galenicals (see Culpepper's "Translation of the Pharmacopœia," 1653; there is a copy in the library of the Pharmaceutical Society). Jacob Bell, in "A Concise Historical Sketch of the Progress of Pharmacy in Great Britain," after alluding to these chemical medicines, which were of mineral origin and prepared by fire, and the galenicals, which comprised the herbs, roots, and other vegetable or animal substances, goes on to state that: "The trade in these articles was also distinct, and chymists are alluded to in works of the date now under consideration [1653] as being a class of men who prepared these mineral compounds for the use of the apothecaries." Very much of my knowledge of the history of the "Chemist and Druggist" is derived from this little book by Bell. It contains 108 pages, and was published by Churchill in 1843. Copies are rare. I have one myself and there is one in the library of the Pharmaceutical Society at Bloomsbury Square. Its quotations and references, many of which I have verified, cover the period between 1511 and 1843. I will select a few bearing on this subject of chemists and chemists.

1671.—The author of the pamphlet, of this date, entitled "The Wisdom of the Nation is Foolishness," tells of a Dr. Merret who had recently given an account of certain apothecaries (that is compounders of goods supplied by the druggist, on the one hand, and the chemist on the other; for the "Chemist *and* Druggist" had not apparently yet come into existence). "Chymists which sell preparations honestly made complain that few apothecaries will go to the price of them. . . . . All the drugs imported into England sooner or later are made into medicines, although they have lain by years with the

merchant, druggist, and apothecary before they are used."

1680.—In some rhymes of this date a sort of apothecary-chemist is thus alluded to:—

"'Mongst all professions in the town,
Held most in renown
From th' sword to the gown,
The upstart chymist rules the roast;
For he with his pill
Does ev'n what he will,
Employing his skill
Good subjects to kill,
That he of his dangerous art may boast.

O 'tis the chymist, that man of the fire,
Who, by his black art,
Does soul and body part;
He smokes us and choaks us
And leaves us like Dun in the mire."

1680.—In this year the Hon. Robert Boyle's assistant, Godfrey, or, rather, Ambrose Godfrey Hanckwitz, started a business in Southampton Street, Covent Garden, which has only quite recently been removed farther west by the present successor of "Godfrey and Cooke." Here is his original advertisement, interesting alike to chemists and chemists:—

"Ambrose Godfrey Hanckwitz, Chemist in London, Southampton Street, Covent Garden, continues faithfully to prepare all sorts of remedies, chemical and galenic. He hopes that his friends will continue their favours. Good cordials can be procured at his establishment, as well as Royal English drops, and other articles, such as Powders of Kent, Zell, and Contrajerva, Cordial red powder, Gaskoins powder, with and without bezoar, English smelling salts, true Glauber's salt, Epsom salt, and volatile salt of ammonia, stronger than the former. Human skull and hartshorn, essence of Ambergris, volatile essence of lavender, musk and citron, essence of viper, essence for the hair, vulnerary balsam, commendeur, balsam for apoplexy, red spirit of purgative cochliaria, spirit of white cochliaria, and others. Honey water, lavender water of two kinds, Queen of Hungary water, orange-flower water, and arquebusade.

"For the information of the curious, he is the only one in London who makes inflammable phosphorus, which can be preserved in water. Phosphorus of Bolognian stone, flowers of phosphorus, black phosphorus, and that made with acid oil, and other varieties. All unadulterated. Every description of good drugs he sells, wholesale and retail.

"Solid phosphorus, wholesale, 50s. an ounce, and retail £3, sterling, the ounce."

A copy of a portrait of Godfrey, engraved by George Vertue (1718), is in the possession of Messrs. Godfrey and Cooke. Copies of this picture he distributed among his customers, Bell says, as a keepsake. "Hâc Amicitiæ tesserâ Fautoribus valedicit Peregrinaturus Ambrose Godfrey Hanckwitz, Chymicus ad Phœnicem, Londini." This "Chemist at the sign of the Phœnix, London," safely received a letter from Berlin, Ince says, on January 31, 1719, bearing the simple inscription, "For Mr. Godfrey, famous Chymist in London." (See an excellent article on Godfrey by Joseph Ince in the *Pharmaceutical Journal*, 1858-59, pages 126, 157, and 215.

1686. Here is another advertisement. "Gaza Chymica. A magazine or storehouse of choice chymical medicines, faithfully prepared in my laboratory, at the sign of Hermes Trismegistus, in Watlin Street, London—by me, George Wilson, Philo.-Chym."

1691, "Pharmacopœia Bateana;" 1703, "The Craft and Frauds of Physicians exposed;" and, 1704, "Tentamen Medicinale," throw a good deal of light on the history of pharmacy.

1724.—Public papers of the 13th, 14th, 15th, and 16th of June contain the following paragraphs:—"On Wednesday last, the four censors of the College of Physicians, and the two wardens of the Apothecaries' Company, visited several chymists, druggists, and apothecaries' shops, pursuant to the authority granted them by a late Act of Parliament, and we hear they burnt several drugs and other things in the medicinal faculty, before the doors of Mr. Goodwin, chymist, facing the Haymarket, the corner of Pall Mall," &c. It is only fair to Goodwin's memory to state that he seems to have been the victim of spite, and that he recovered £600 damages for the injustice he had sustained.

1732.—In this year, Boerhaave, of Leyden, published the celebrated two thick quarto volumes, which, Rodwell says, was for many years the chemical text-book of Europe. What was chemistry at this date? It was what we should term pharmaceutical chemistry. Who were the chemists who followed this chemistry? Men whom we might term pharmaceutical chemists. Show this first text-book of chemistry to any intelligent man of the present day, without allowing him to see the title-page or the physical sections, and he would say, "This is an old book on pharmacy." Boerhaave possessed the scientific spirit; he sought to discover "the causes" of chemical changes, but he rightly treated the chemistry of his day as an art. One quotation will suffice. It is from page 49 of the English translation, by Dallowe, 1735, a copy of which is in the Pharmaceutical Society's library. "The effects of this art the chemists have reduced principally to four *classes*; which are all produced either by adunation, or separation. When, for instance, they resolve a body into any distinct part which they collect and separate from it, they call this operation extraction, and to those parts chiefly which are the most considerable they give the name of an *extract*. Thus, when they draw from wormwood the penetrating bitter part only, they call it the extract of wormwood; as the most subtil part of iron artificially separated from it goes always by the name of extract of iron. Hither, therefore, are referred a great number of operations, which may be performed on the same body, as distillation with water, or without it; decoction, and the inspissation of this decoction through different degrees; tinctures, let the *Menstruum* made use of be what it will; &c."

I do not mean to say that Boerhaave recognised no man as a chemist unless he were a maker or vendor of chemicals, for he says (vol. ii., page 2) "Nothing has prov'd more fatal, both to the chemical and medicinal art, than an idle opinion, that all kinds of chemical productions were proper to be made use of as medicines." Still the opinion, though idle, was the opinion, and it was Boerhaave himself who did so much to correct it, by showing that, although the chemical art "furnishes us with proper help for securing and restoring of health," it also "opens to the human mind the powers of nature." At the same time, however, Boerhaave apparently regarded the makers and vendors of chemicals and drugs as *the* chemists; for he reproved those of "the chemists" who practised physic without sufficiently understanding it, while he also hoped that "Gentlemen of the faculty, who are such enemies to the chemists, would consider this affair [the use of chemistry in medical practice] in a proper light; and then they would not so rashly condemn an art whose assistance may be of service to medicine, but cannot possibly do it any prejudice."

1748.—The Apothecaries' charter of this date was intended to restrain chemists and druggists from practising pharmacy, that is, compounding prescriptions. It failed. The apothecary (originally only "a preparer of drugs for medicinal uses") was then gradually becoming what to-day he is, namely, a medical practitioner, while the chemist and druggist was as gradually succeeding him as a preparer and compounder of medicines.

The foregoing information will probably suffice. The alchemist became the chemist. The drug-grocer became the druggist. The chemist and the druggist gradually amalgamated, afterwards, also, becoming a compounder of physicians' prescriptions. The whole of the chemistry of the time of Boerhaave, which he so well taught to his medical and other pupils, is embraced in what is modestly termed pharmacy in 1878. The only chemist of his day, a

regards knowledge, and commonly, also, as regards practice, was such a man as the chemist and druggist of the present day. Some physicians, as I have said, and a few men of wealth, worked at the art, and did much towards laying the foundations of the present structure of chemical science, but the men recognised generally as chemists 200 years ago are the men recognised as chemists by the great mass of the public now—the makers and vendors of chemicals, the "chemists and druggists." Those of them who date from 1868, many who date from 1842, and not a few of the older followers of pharmacy, claim to be not only makers and vendors of chemicals, but students of the science of chemistry. As a class, however, they know well that *now* there are in England chemists who more thoroughly study chemistry than necessarily they do, and they nearly always term themselves "chemists *and druggists*," or sometimes pharmacists: or, after passing a somewhat severe "Major" examination, they are allowed (and they only are now allowed) the title "Pharmaceutical Chemist."

One word to the "Credulous Chemist." I trust he will retain his conviction, *unshaken*, "that the designation of chemist pertains only secondarily to the student and worker, and primarily and distinctively to the dealer [may I add, and student also] in chemicals." If so, I would appeal to him to give—at some early date, and in any way he pleases—to give to his conviction the weight of his name. He would be doing an act of justice to "chemists and druggists," while to those other chemists, your readers, his opinion on the matter would, I am sure, be accepted as entirely conclusive.—I am, &c.

JOHN ATTFIELD.

Ashlands, Watford.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris,
No. 5, March 5, 1878.

Reaction Peculiar to Certain Polyatomic Alcohols.—D. Klein.—If borax and mannite be mixed in such proportions that less than ½ equiv. of borax is taken to each equiv. of mannite, the liquid is acid. If ½ equiv. of borax is employed, the liquid is neutral, but on treating the mixture with alcohol there remains a peculiar compound, the same as that produced on mixing the two substances equivalent for equivalent. The alcohol removes the excess of organic matter. If borax is added in excess, it crystallises, and the organic matter remains merely in combination with 1 equiv. of borax. If an aqueous solution of borax is poured into a concentrated solution of any of the following polyatomic alcohols: glycerin, erythrite, mannite, levulose, dextrose, and galactose (α and β), the polyatomic alcohol being in excess, an energetic acid reaction is immediately set up. The liquid turns blue litmus, the yellowish red shade characteristic of the more powerful acids, and the mixture attacks calcic and barytic carbonates. If the liquid is diluted with water, the blue colour of the litmus is restored. If any of the above alcohols is added to a dilute aqueous solution of boracic acid, too weak to redden blue litmus paper, an acid reaction is also developed, even if a solution containing merely 1-20000 of boric acid is brought in contact with mannite. With quercite, no similar reaction was obtained. The alkaline earthy biborates yield similar results to borax.

Reaction of Boric Acid in Presence of Mannite.—D. Klein.—Five c.c. of a solution containing 1-100000 of boric acid mixed with the same volume of a solution of mannite, containing 15 per cent., reddened blue litmus slightly, after a minute.

A Manganese Blue.—M. Gaston Bong.—This blue is obtained on igniting silica, and any compound of manganese, with baryta, or a mixture of soda and lime in an oxidising atmosphere. Either of the following mixtures may be used:—

Silica	3	or	Silica or kaolin	3	or 2
Soda-ash ..	6	,,	Barium nitrate		8
Carb. of lime (free from iron)	5	,,	Oxide of manganese (free from iron)		3

The proportion of manganese affects the intensity of the blue, but not its tone. By increasing the proportion of alkali or silica, a green or a violet tone is produced. The use of potassa does not give good results. The ignition should be effected at a red heat, in the absence of reducing gases. These facts lead to a very delicate process for detecting the presence of manganese, especially in earthy substances. If to one of the above mixtures, made of materials free from manganese, any substance containing a trace of that element is added, a blue colour appears on ignition.

Chrome Blue.—M. Gaston Bong.—The following materials are intimately mixed and strongly calcined with free access of air:—

Boric acid	15 parts.
Alumina..	15 ,,
Carbonate of magnesia	20 ,,
Chromate of baryta	2 ,,

Transformation of Bromated Hydrocarbons of the Ethylen Series into Bromides of Acids of the Fatty Series, by the simple addition of Oxygen.—E. Demole.—The author describes the action of dry oxygen upon dibromated ethylen, the preparation of tribomated ethylen and its behaviour with oxygen. (Rusian Chemical Society, Session Nov. 13/25, 1877. Noticed elsewhere.)

Biedermann's Central-blatt,
Heft 11, November, 1877.

Use of the Waste-Waters of Starch Works for the Irrigation of Meadows.—C. de Leeuw.—The author reports that this very offensive liquid has been found useful for the purpose mentioned.

Influence of the Surface of Leaves upon the Evaporation of Plants.—Dr. F. Tschapowitz.—The amount of evaporation rises and falls with the total amount of leaf-surface. Large leaves, however, seem to have a relatively greater evaporating power than small ones.

Discolouration of Green Leaves in Intense Sun-Light.—Prof. J. Böhm.—There is a maximum intensity beyond which the action of light upon vegetation is injurious. In such cases leaves are first bleached, then turned brown, and of a metallic lustre, and finally destroyed. The under surface of leaves is much more sensitive than the upper.

Nitrogenous Constituents of Feeding-Beets.—Prof E. Schulze and Dr. A. Urich.—The most important of these reserves of nitrogen are amides—glutamin and asparagin—and betain.

Cultivation of Sugar-Beets.—A. Ladureau.—A hectare of good land without manure gave 48,000 kilos. roots with 10·80 per cent of sugar in the juice; manured with the drainage of dung-hills, 61,500 kilos., with 10·25 per cent. Soda saltpetre brought the percentage of sugar down to 8·36; earthnut cake to 9·61, and complete chemical manure to 10·07. The chemical manure was very useful in destroying insects.

Comparative Experiments on the Formation of Fructose from Sucrose and Sulphuric Acid.—Fr. Anthon.—The most favourable results were obtained by

boiling cane-sugar for forty-five minutes with twice its weight of water and 1 per cent of sulphuric acid.

Solubility of Magnesia, Baryta, and Sulphate of Lime in Solutions of Sugar.—H. Pellet.—Magnesia is not quite insoluble in saccharine liquids; baryta is more soluble than in water. At ordinary pressure the solubility of calcium sulphate in water is little affected by the pressure of sugar.

Investigations on the Manufacture of Alcohol.—M. Delbruck.—An extensive memoir not suitable for abstraction.

Detection of Foreign Colouring Matters in Red Wines.—Profs. Nessler, Gautier, Hilger, Griessmayer, and Vogel.—A variety of methods are proposed, most of which are already known. Sulphate of copper is said to remove the colour of pure wines, leaving that of sophisticated samples unchanged.

Determination of Nitrogen in Albumenoid Substances.—A collection of the opinions of a great number of chemists on the relative value of the methods of Dumas and of Will and Varrentrapp.

Les Mondes, Revue Hebdomadaire des Sciences, No. 7, February 14, 1878.

It is proposed to display two electric lights on the towers of Notre-Dame during the approaching Exhibition.

During the past year 10,619 horses, mules, and asses have been used for human food in Paris.

Mania metaphysica (Grübel-sucht) is recognised as a new form of mental disease. It shows itself chiefly in young people in constant and useless inquiries into the why and wherefore of things, and is to be treated by small doses of potassium bromide.

Support for Regulating the Production of Gases (Hydrogen and Carbonic Acid).—H. Sainte-Claire Deville.—This apparatus cannot be described without the aid of the accompanying cut.

Note on the Telephone.—A. Demoget.—The author calculates that the sound transmitted by the telephone is 1,500,000 times weaker that that emitted by the speaker. He considers that as a machine it is still very imperfect.

Revue Universelle des Mines, de la Metallurgie, &c., November and December, 1877.

This issue does not contain any chemical matter.

MEETINGS FOR THE WEEK.

MONDAY, April 1st.—Medical, 8.
— London Institution, 5.
— Royal Institution, 2. General Monthly Meeting.
TUESDAY 2nd.—Civil Engineers, 8.
— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
— Zoological, 8.30.
WEDNESDAY, 3rd.—Society of Arts, 8. "Our Wealth in Relation to Imports and Exports, and the Causes of Decline in the Latter," Mr. Ernest Seyd.
— Geological, 8.
— Microscopical, 8.
— Pharmaceutical, 8.30.
THURSDAY, 4th.—Royal, 8.30.
— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
— London Institution, 7.
— Chemical, 8. "On the Application of the Microscope to some Special Branches of Chemistry," H. C. Sorby, F.R.S.
FRIDAY 5th.—Royal Institution, 8. Weekly Meeting. "The Philosophy of the Beautiful," Mr. G. J. Romanes, 9.
— Geologists' Association, 8.
SATURDAY, 6th.—Royal Institution, 3. "On the Clavecinists of England, Italy, France, and Germany, and their Works," with Musical Illustrations on the Harpsichord and Pianoforte, Prof. Pauer.

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 958.

SHORT REPORTS FROM THE CHEMICAL LABORATORY OF TRINITY COLLEGE, DUBLIN.

By J. EMERSON REYNOLDS, M.D.
Professor of Chemistry, University of Dublin.

No. V.

ON THE RAPID ESTIMATION OF UREA.*

A DISTINGUISHED physician, who wished to make frequent determinations of the urea daily excreted by a patient, requested me to devise a method which would enable him to make the desired estimation—(*a*) rapidly, (*b*) with sufficient accuracy for ordinary clinical purposes, (*c*) with simple and easily constructed apparatus, and (*d*) without the use of a balance or of any measuring vessels other than the fluid ounce and minim measures which a medical man is in the habit of employing.

This interesting practical problem was solved in the manner I shall presently describe, and the results obtained by the use of the method devised have been so satisfactory as to lead me to expect that it may be found generally useful where a high degree of accuracy is not desired.

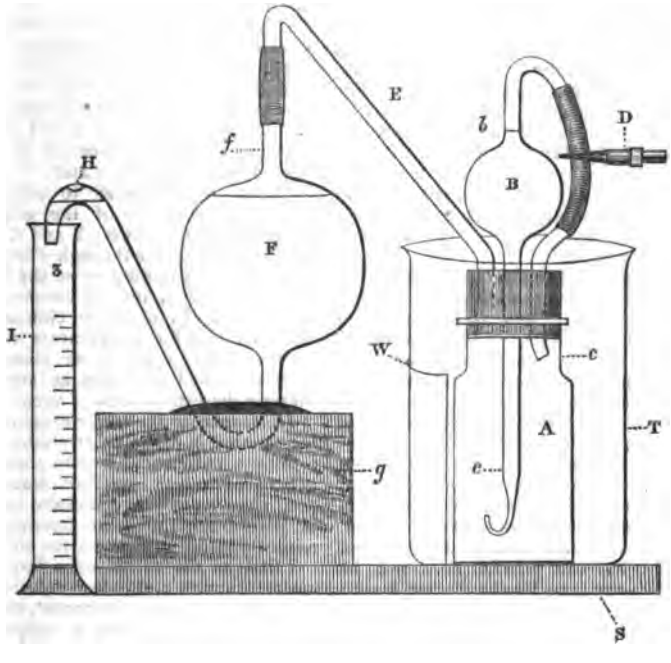
Before concluding this paper, however, I propose to describe a less simple plan for the estimation of urea than that just referred to; but one which is capable of affording results of greater precision.

In both the methods mentioned I take advantage of the now well-known reaction of sodic hypobromite with urea. When a strongly alkaline solution of sodic hypobromite is added to a liquid containing urea, the latter suffers rapid decomposition into water, carbonic anhydride, and pure nitrogen gas. The carbonic anhydride is not evolved as gas, but is absorbed, with formation of sodic carbonate, by the free alkali of the liquid used to effect decomposition; the nitrogen is evolved in the gaseous condition, and its bulk determined either indirectly or directly, the volume of nitrogen produced thus serving as a measure of the urea from which it was derived.

The equation which expresses the change just referred to is the following:—

$$\underbrace{CO''N_2H_4}_{\text{Urea}} + 3\underbrace{(NaBrO)}_{\substack{\text{Sodic}\\ \text{Hypobromite}}} + 2(NaOH) = 3NaBr + Na_2CO_3 + 3H_2O + 2N.$$

The use of calcic hypochlorite, or solution of "chloride of lime," in effecting a similar decomposition was pointed out by Dr. E. W. Davy,* and it has been recently shown by Yvon† that the hypochlorite used by Davy is more effective than the sodic hypochlorite, but it does not evolve the whole of the nitrogen and is irregular in its action. Knop, and after him Hüfner,‡ and many others, have shown that the sodic hyprobomite is greatly to be preferred to any of the hypochlorites, as the decomposition of urea is almost complete, and progresses regularly and rapidly without the aid of heat; hence I use the hypobromite as the basis of the plan of operating now to be described, and in this respect agree with Hüfner, Russell and West, R. Apjohn, Blackly, (Dupré, and with Simpson and O'Keefe)§ in the methods they have proposed for urea estimation.



The different methods devised by the above-named chemists all serve for the *direct* measurement of the volume of nitrogen evolved during the action of the hypobromite on urea, and involve the use of specially graduated tubes for the reception and measurement of the pure gas. My plan is essentially different, as the gas evolved, which is scarcely soluble in water,‖ is made to

* Read March 19th, 1877.

* *Journal of the Royal Dublin Society and Phil. Mag.*, [4], vol. vii., p. 403.
† *Journal de Pharmacie et de Chimie.*, [4], vol. xxiv.
‡ *Journal für Praktische Chemie.*, [2], vol. iii., p. 1.
§ Published since this paper was read.
‖ According to Bunsen, water dissolves only 0·01478 of its volume at the mean temperature and pressure ("Bunsen's Gasometry," p. 286).

displace its own volume of that liquid, and the latter is then easily measured in any ordinary vessel, such as a tall and well graduated drachm measure.

The apparatus may be most conveniently described as consisting of two distinct parts—A, the generating vessel (see annexed woodcut, Fig. 1), and F the small gas holder from which water is expelled by the nitrogen entering from A.

Gas Generating Vessel.—This is an ordinary two-ounce wide-mouthed bottle, fitted with a good india-rubber cork, pierced with three holes. Through one of these holes the gas delivery tube E passes, and through another the small piece of bent glass, tube C. The heat afforded by a spirit lamp suffices for bending these tubes from straight pieces, and for the conversion of an ordinary bulb pipette capable of holding rather more than one fluid ounce into a vessel of the form B.

The delivery tube of the pipette is first passed through the remaining hole in the cork, and the end of the tube then drawn out and recurved, as shown at *e*; the tube above *b* is bent so far down as to admit of its being connected by means of an india-rubber tube with the outer extremity of C. At D the india-rubber tube is securely clipped by a small artery forceps with broad jaws. When the cork carrying the tubes just described is secured in the bottle, the generating vessel is complete. When an estimation is in progress the bottle A is placed in a tumbler T (or beaker), containing cold water at a temperature of 52° F., as nearly as possible.

The Gas Receiver.—This is easily constructed from a large pipette whose bulb, F, is capable of containing about three fluid ounces. The tube *f* is cut off so as to admit of being securely joined to the tube E of the generating vessel by means of an india-rubber connector. The delivery tube is then bent, as shown, and at the point H a little hole is made. A groove cut in a block of wood *g* receives the bent tube of the little gas holder, which is then easily secured in its place by any suitable cement—common sealing wax, for example. Thus, with the aid of the two pipettes, cork, and tubing, which can be easily procured through a druggist for about 3s., a medical man can construct his own ureometer.*

When in use the block *g* is secured to the board S on which the beaker T stands held by the wire W.

Mode of Using the Apparatus.—The vessels A and F are disconnected, and F filled with water until it overflows and the excess has ceased to drip from the tube under H. The cork is removed from the bottle A, and two fluid drachms of the liquid to be tested measured off in a tall minim measure, and then poured into A; one drachm of water is next used to rinse the liquid adhering to the sides of the measuring glass into the bottle A; the total volume in A therefore should measure about three drachms.† For a reason which will presently appear, it is desirable that no more water than one drachm should be employed. If a pipette delivering two drachms be used, a drachm of water should be added; but the pipette need not be rinsed with it. The next step is to fill the pipette B with the reagent which evolves the nitrogen of the urea. For this purpose a suitable vessel—a wine-glass for example—is filled with the hypobromite liquid;‡ the forceps D are removed from the india-rubber tube, but are placed close at hand, and a piece of vulcanised tubing, five or six inches long, attached to the end of the glass tube C; suction is then applied by the mouth, when the curved end *c* of the pipette is immersed in the hypobromite. The pipette is thus easily filled by suction with the reagent up to the mark *b*. The forceps D are next applied to the connector, as shown, *before* the lips are withdrawn from the india-rubber tube attached to C; the suction tube may then be removed from *c*, as the liquid is retained in B by atmospheric pressure, provided D pinches the tube well. Having washed the end *c* by pouring a little water over it, the cork carrying all its apparatus is securely inserted in the bottle A, the latter placed in the beaker T containing enough water to cover the cork when A is pressed down, and the tube E securely connected by the tightly-fitting india-rubber tube with *f*. While connecting the generator and receiver a little water is necessarily expelled from the tube beyond H, but this water is thrown away and the *dry* two-ounce measure I then placed under the spout.

Up to this point the hypobromite has not been allowed to come in contact with the urine, but now on removing the forceps D the hypobromite flows out from *c* and rapidly mixes with the urine, the urea of which yields up its nitrogen gas with effervescence. As the gas evolved has no exit save through E it displaces from F its own volume of water, which falls into the vessel I, and can then be measured, when no more water is expelled. The effervescence ceases after five or ten minutes, according to the temperature.

It is essential to good measurement that the pressure within the apparatus should be the same at the end as at the beginning of the experiment; in order to secure this, the simple plan is adopted of placing a wedge under the board S at the end indicated, which is thus so tilted that the eye placed at a point a little below D, and looking immediately above the surface of the water in F, can just see the bend of the tube under H. When the pressure within and without has been thus equalised the amount of water expelled is the measure of the nitrogen evolved in A, for we may in a test of this kind neglect the extremely minute proportion of the nitrogen which has been dissolved by the water.

When it is desired to correct for temperature and pressure, by means of the usual formula, it is now necessary to disconnect E and *f*, and to pass the bulb of a small thermometer through *f* into the gas over the water in F; after a minute or so the temperature may be read off and recorded, and the barometric reading made at the same time. In ordinary clinical experiments, however, the correction for temperature may be neglected when a thermometer in the room stands near to 52° F. The neighbourhood of a fire or stove must be avoided in making the estimations of urea.

In measuring the water expelled we may either read off the volume in drachms or sixths of a drachm; but since ordinary cylindrical two-ounce measures are rarely graduated to less than half drachms, the *best* plan is to pour the excess over a definite number of drachms into a tall two-drachm measure, bearing in mind that every ten-minim division represents the sixth of a drachm.

I find as the result of a large number of direct experiments with a standard solution of pure urea, some of which will be given farther on, that *one grain of urea produces sufficient gas at a temperature of 52° F. and a barometric pressure of* 30·06 *inches to expel* 6½ *drachms of water*, the volume of liquid in the bottle A being three drachms, and the hypobromite added ten drachms.

It may be mentioned that measures of capacity need not be employed in the determinations of urea, as the water expelled may be received in any suitable vessel which has been previously weighed. At the end of the experiment the vessel and expelled water are weighed. When the estimation was made under the condition above named *one grain of urea was found to expel, as a mean*, 365 *grains of water by weight*. This number is easily remembered, as it happens to be identical with the number of days in a year.

Effect of the Degree of Dilution upon the Determination of Urea.—An apparently trifling observation led me to examine the effect of dilution upon the yield of nitrogen

* Messrs. Yeates and Son, of this city, supply a neat form of my apparatus ready for use.

† The measures used should be good, the two-drachm and two-ounce vessels agreeing with each other. The amount of reliance which can be placed upon the results depends in great part on the accuracy of the measures.

‡ This solution is prepared as follows:—Dissolve 4 ounces of the solid caustic soda of the shops in 10 fluid ounces of water. When the soda has dissolved and the liquid cooled to 60° F., add gradually one fluid ounce of bromine. The test solution is then ready for use. It should be kept in a cool place, and away from the light.

obtainable from a constant weight of urea, and the results arrived at are stated in the table given below.

The quantity of pure dry urea operated with in each of the following experiments was 2·222 grains, and the same volume (*i.e.* ten fluid drachms) of a single sample of freshly prepared sodic hypobromite was added in each case. The experiments were completed within three and a half hours, and care was taken to avoid changes of temperature as much as possible; hence, while the barometer remained steady at 30·06 inches, the temperature varied within such very narrow limits (between 50° and 52° F.) that corrections for alterations of volume were unnecessary, as extreme accuracy in the measures of the water expelled was not attainable with the vessels advisedly employed, as I desired the results to be of such a kind as a medical man could easily obtain in his own study.

TABLE.

Experiment No.	Pure, dry Urea used in Experiment.	Volume of Water used to dissolve Urea in A.	Volume of Water expelled from F.
1 ..	2·222 grains,	0 drachm,	15½ drachms.
2 ..	,,	1 ,,	15 ,,
3 ..	,,	2 ,,	14½ ,,
4 ..	,,	2 ,,	14½ ,,
5 ..	,,	3 ,,	14½ ,,
6 ..	,,	3 ,,	14½ ,,
7 ..	,,	4 ,,	14½ ,,
8 ..	,,	5 ,,	Lost.
9 ..	,,	6 ,,	14 + ,,
10 ..	,,	7 ,,	13½ ,,
11 ..	,,	8 ,,	13½ ,,
12 ..	,,	9 ,,	13½ + ,,
13 ..	,,	10 ,,	13½ + ,,

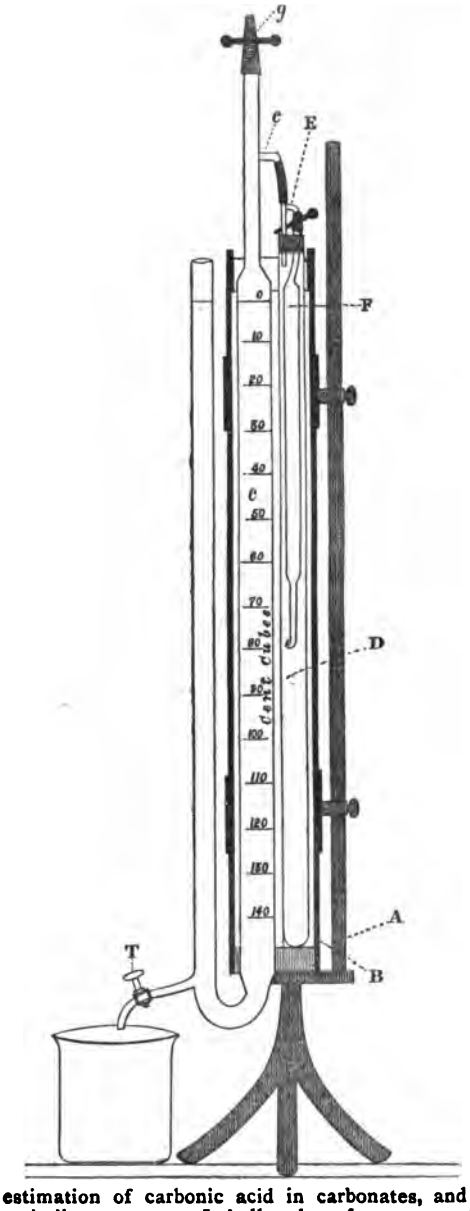
The weight of urea taken for each experiment is capable of affording a volume of moist nitrogen gas at the temperature and pressure above stated, which would expel 15½ drachms of water. The maximum volume obtained from that weight of pure dry urea was 15½ drachms. Thus there is a minimum loss of 3·3 per cent. The maximum observed loss in the foregoing experiments amounted to 14·9 per cent., and occurred in the experiment in which the above-named weight of urea was dissolved in ten drachms of water. The loss within the above limits is tolerably regular, as the volume of nitrogen is diminished by ¼th of a drachm (nearly) for each drachm of water added to the urea in the decomposition vessel A.

The loss of nitrogen referred to is, doubtless, due in part to solution of the gas, but it is chiefly attributable to the regular diminution of the strength of the oxidising agent used—the hypobromite solution—and to a corresponding increase in the extent of the secondary changes which are known to occur in the diluted liquids, and which involve a loss of gaseous nitrogen. Much of the error arising from the latter cause is avoided by adopting the plan of employing a constant volume of liquid: hence the recommendations already made that two drachms of urine should be measured into the bottle A, and the measure rinsed out with not more than one drachm of water. The total bulk of liquid in A ought then to measure as nearly as possible three drachms. Even when the sample to be tested is measured with a pipette, it is well to add one drachm of water from an ordinary measure in order to bring up the total volume of liquid to the amonnt recommended.

When the simple precautions are taken which I have already mentioned, the little apparatus described in this paper will enable a considerable number of estimations of urea to be made with rapidity, and with sufficient accuracy for ordinary clinical purposes. When very precise determinations are required, Liebig's process must be resorted to, as all the methods in which hypobromites or hypochlorites are employed are liable to the errors pointed out above; the accuracy of the results are also affected by the action of the reagent used on uric and hippuric acids, creatinine, and other nitrogenised compounds. On the other hand, when we desire to ascertain the total amount of nitrogen excreted by the kidneys, it is necessary to resort to the precise method of estimation which I communicated to the Surgical Society of Ireland.*

Estimation of Urea by Direct Determination of the Nitrogen Gas Evolved by Sodic Hypobromite.

The piece of apparatus now to be described was exhibited at a meeting of the Scientific Club in 1871, and has proved most useful for the estimation of urea by the hypobromite method, and, with a little modification, for



the estimation of carbonic acid in carbonates, and for other similar purposes. I shall only refer at present to its use in ureometry. In this apparatus the nitrogen evolved is directly measured as gas under conditions which admit of very accurate determinations of volume in cubic centimetres.

* *Vide Medical Press and Circular*, May 13, 1874, p. 402.

The apparatus is shown in section in Fig. 2. The stand A supports a tall glass cylinder B. Through the large india-rubber cork which closes the lower opening of the cylinder the U tube *c* is passed, great care being taken to avoid breaking the small T connector *c*. The outer limb of the U tube is provided with a glass tap T. The limb within the tall glass cylinder is sufficiently wide to contain 150 cubic centimetres in the expanded portion, which, in my apparatus, measures sixty centimetres in length. The graduation cannot be conveniently carried beyond fifths of a cubic centimetre. At the point shown an india-rubber tube *g* is attached, which can be closed at will either by a good clip or by a stopper of glass rod. The glass side tube *c* serves to connect the measuring apparatus in the manner shown with the generating vessel D, which is a long and wide glass tube placed within the cylinder. The glass T tube E is connected by means of rubber tubing with *c*, while one limb passes through the india-rubber cork of D, and the other is connected by another piece of rubber tubing with the fine tube of the long pipette F (of about 20 c.c. capacity), which projects through the cork. This connection must be sufficiently long to admit of the clip being applied as shown.

The large glass cylinder B is filled with water, in order to maintain a steady temperature, the value of which can be be known by means of a thermometer immersed in the water.

A determination is made with this apparatus in the following way:—Having disconnected the T tube E from *c* and the clip, the generating tube D is taken out of the water of the cylinder, the cork carrying the pipette, &c., withdrawn, and then five cubic centimetres of the urea solution introduced into the tube D. Before replacing the cork the pipette F is filled with hypobromite solution by suction above E, while the small glass tube opening on the under side of the cork is closed by a finger; the clip is then applied. The exterior of the pipette is now washed with a little water, and the cork, with the apparatus attached, is then replaced in position; the tube D again immersed in the water of the large cylinder, and the connection between E and *c* securely made. Before making the connection the water in the graduated tube should stand at the zero of the scale, but after making the joint the pressure within the apparatus is usually greater than that without. As the air in the tube D cools down to the temperature of the surrounding water, contraction takes place; but should the water not return to the zero, equilibrium is at once restored by opening the fine india-rubber tube *g* for a few seconds, and then closing in such a manner as to prevent any possible escape of gas.

The hypobromite is brought in contact with the urea solution by removing the clip from the india-rubber tube connected with the pipette; the reagent then falls from a considerable height, and mixes thoroughly with the liquid at the bottom of the tube D. Nitrogen is evolved and displaces water from *c*, the water being maintained at the same level in both limbs of the U tube by allowing the liquid displaced to run off by means of the tap T. When the evolution of gas has ceased, the water level is adjusted by means of the tap, and the volume of gas produced in the reaction then read off on the graduated tube *c*; the temperature of the water in the cylinder B is then ascertained, as well as the height of the barometer at the time. From the data thus obtained, the volume of dry nitrogen at 0° C. and 760 m.m. can be easily calculated by the usual formula.

THE ATOMIC WEIGHT OF GALLIUM.

AT the meeting of the *Academie des Sciences* on the 25th ult., M. Lecoq de Boisbaudran announced that he had prepared several anhydrous chlorides, bromides, and iodides of gallium. He has also determined the atomic weight of the new metal. The mean of two experiments showed it to =69·9.

ON THE

SULPHATES OF THE VANADIUM PENTOXIDE.

By Dr. B. W. GERLAND.

(Concluded from page 128).

Basic Vanadylic Sulphate, $V_2O_2,O.2SO_4$.—The solution of vanad-pentoxide in a large excess of sulphuric acid—which, as just shown, deposits crystals of the neutral vanadylic sulphate at the temperature of boiling vitriol—forms, when kept for a length of time at 130° to 150°, crusts of crystals of different appearance. They are hard and heavy, opaque, and of bright red colour; they deliquesce in air to a clear brown liquor, which can be mixed with water without decomposition; but heating, and even time alone, causes separation of amorphous vanadic acid retaining a small amount of sulphuric acid. In contact with liquid water this decomposition immediately takes place. These crystalline crusts were crushed, and left between porous stones in a dry atmosphere. The analyses of three preparations yielded the following results:—

(1.) 0·8359 grm. substance gave $BaSO_4$, 1·2099 grm. V_2O_5=10·7 c.c. permanganate solution (1 c.c.= 0·03748 grm. V_2O_5).

(2.) 1·0264 grm. substance gave $PbSO_4$, 2·0497 grm.; V_2O_5=12·1 c.c. permanganate solution.
0·8759 grm. substance gave H_2O, 0·0430 grm.

(3.) 0·8094 grm. substance gave $PbSO_4$, 1·5574 grm.; V_2O_5, 0·3937 grm.; and K_2SO_4, 0·0072 grm.

Calculated for	(1.)	(2.)	(3.)	Calculated for $V_2O_2,O,2SO_4$.	Calculated for $V_2O_2H_2,2SO_4$
V_2O_5 ..	47·97	44·19	48·64	53·30	50·63
SO_3 ..	49·69	52·72	50·80	46·70	44·37
K_2O ..	—	—	0·88	—	—
H_2O ..	—	4·90	—	—	5·05
		101·81		100·00	100·00

These analyses show that no pure compound was obtained, but that the crystals formed in the solution of vanad-pentoxide in a large excess of sulphuric acid at a lower temperature contain less sulphuric trioxide than those octahedrons deposited at the boiling-point of sulphuric acid. They also make it probable that the pure compound is anhydrous, and represented by the formula $V_2O_2,O,2SO_4$, and this is almost proved by the agreement of its properties with the pure substance prepared as described below. The formation of these crusts has been observed by Fritsche, but this author supposed it to be composed according to the formula $V_2O_2,O_2H_2,2SO_4$ (Liebig and Kopp, *Jahresbericht*, 1851, p. 351).

The compound $V_2O_2,O,2SO_4$ is obtained pure by heating the neutral salt to a higher temperature. At the temperature of melting lead the latter gives off fumes of sulphuric trioxide, which suddenly cease, and the residue then consists of a crystalline mass, with shining faces of dark red colour whilst hot, changing to brick colour on cooling. Its behaviour in the air and in contact with water is the same as that described of the crystalline crusts obtained from solution in sulphuric acid at 150°. Three preparations were submitted to analyses with the following results:—

(1.) 1·6509 grm. substance gave insoluble $V_2O_2,2SO_4$, 0·0405 grm.; $BaSO_4$, 2·2260 grm.; V_2O_5=23·31 c.c. permanganate (1 c.c.=0·03766 grm. V_2O_5.)

(2.) 0·8903 grm. substance gave insoluble $V_2O_2,2SO_4$, 0·0317 grm.; $BaSO_4$, 1·1968 grm.; V_2O_5=12·39, c.c. permanganate (1 c.c.=0·03766 grm. V_2O_5).

(3.) 0·7503 grm. substance gave insoluble $V_2O_2,2SO_4$, none; $BaSO_4$, 1·0053 grm.; V_2O_5=10·70 c.c. permanganate (1 c.c.=0·03748 grm. V_2O_5).

Calculated for	(1.)	Deducting $V_2O_2,2SO_4$.	(2.)	Deducting $V_2O_2,2SO_4$.	(3.)	Cal. for $V_2O_2,O,2SO_4$.
In. $V_2O_2,2SO_4$	2·45	—	3·56	—	—	—
V_2O_5	53·04	53·40	52·27	53·11	53·45	53·30
SO_3	46·29	46·60	46·15	46·89	45·95	46·70
	101·78	100·00	101·98	100·00	99·40	100·00

Double Salts of Vanadylic Sulphate.—A compound of vanadylic sulphate with potassium is readily obtained by mixing the solution of the former with the solution of a potassium salt. The mixture remains clear provided it is not more than lukewarm, and begins sooner or later, according to concentration, to separate crystals of the new compound. If sufficient potassium salt is present the solution ultimately retains only a very small amount of vanadium; but if the temperature is above 40° a slimy deposit appears, which gradually increases until the whole is gelatinised. The crystals are separated from the mother-liquor, quickly rinsed with small quantities of cold water, pressed between filter-paper, and dried over sulphuric acid. They are obtained from concentrated solutions in thick heavy crusts of amber colour, and from dilute acid solutions in single transparent individuals of bright sulphur colour. Water decomposes them; they do not change in the air, nor in dry air, but lose their water completely at 100°. According to the following analyses this new compound has the composition $K_2O,V_2O_5,2SO_3,6H_2O$. I have tried to obtain an alum by increasing the amount of sulphuric acid in the solution, and by otherwise varying the conditions under which the salt forms, but always obtained the same compound. The liquor obtained by deliquescence of the compound $V_2O_2,O,2SO_4$, mixed with a solution of potassium sulphate or chloride, also yielded the same compound. From dilute solutions containing much free acid, crystals of 2 to 3 m.m. length and great transparency are obtained. My friend, Dr. F. Hurter, has kindly undertaken the crystallographical examination. He has observed two crystallographical axes, but leaves it undecided whether the crystals are monoclinic or anorthic. The following analyses were executed with material of different preparations:—

(1.) 1·0000 grm. substance gave—
$PbSO_4$, 1·1031 K_2SO_4, 0·3025 V_2O_5, 0·3477

(2.) 0·9729 grm. substance gave—
$PbSO_4$, 1·1103 K_2SO_4, 0·2974 V_2O_5, 0·3064

(3.) 1·0008 grm. substance gave—
$PbSO_4$, 1·1458 K_2SO_4, 0·3155 V_2O_5, 0·3278 H_2O, 0·1936

(4.) 1·0006 grm. substance gave— H_2O, 0·1948
0·9980 grm. substance gave—
$PbSO_4$, 0·9006 K_2SO_4, 0·2390 V_2O_5, 0·2692

Calculated for	(1.)	(2.)	(3.)	(4.)	Calculated for $K_2O,V_2O_5,2SO_3,6H_2O$.
H_2O ..	—	—	19·36	19·48	19·82
V_2O_5 ..	34·77	31·49	32·78	33·73	33·52
K_2O ..	16·35	16·53	17·06	16·22	17·29
SO_3 ..	29·12	30·13	30·51	29·80	29·37
			99·71	99·23	100·00

This compound is decomposed by cold water, with separation of a brown amorphous substance; the yellow solution deposits more when warmed. The precipitate obtained by treatment of the crystals with cold water was filtered, washed with small quantities of cold water, pressed, and when dry submitted to analysis.

0·5550 grm. substance gave—
$PbSO_4$, 0·0126 grm, K_2SO_4, 0·0711 grm. V_2O_5, 0·4330

Calculated—

V_2O_5	78·02
K_2O	6·30
SO_3..	0·60
H_2O (by difference) ..	15·08
	100·00

A considerable portion of the potassium is therefore left in an insoluble compound with vanadium, and we may conclude from this that in the yellow crystals sulphuryl and potassium are both united to the vanadyle molecule by oxygen according to the formula—

$$V_2O_2,\begin{cases}O_2.K_2\\O_2.SO_2.\\O_2.SO_2\end{cases}$$

The vanadylic sulphate is acted upon by ammonium sulphate in a similar manner: the resulting compound, however, is without decomposition readily soluble in cold water, and the difficulties attending its purification are thereby much enhanced. The mixture of the concentrated solutions of these two salts has a greenish brown colour like that of the solution of vanadylic sulphate diluted with water. By slow evaporation over sulphuric acid soft crystalline masses of a brick-red colour separate, which appear under the microscope as bundles of parallel transparent needles, about 0·1 m.m. in length. The crystallisation was treated upon a Bunsen filter, twice mixed with a little water, and again sucked off, then—after pressing between filter-paper and drying over sulphuric acid—submitted to analysis:—

0·9528 grm. substance gave AmCl, 0·2292 grm.; $BaSO_4$, 1·0082 grm.; V_2O_5 = 109·1 c.c. permanganate solution (1 c.c. = 0·003070 grm. V_2O_5).

Calculated for		Calculated for $V_2O_5,Am_2O,2SO_3,4H_2O$.
V_2O_5	35·15	39·14
$(NH_4)_2O$	11·69	11·14
SO_3	36·67	34·29
H_2O (difference)..	16·49	15·43
	100·00	100·00

These figures represent approximately the formula $V_2O_5,Am_2O,2SO_3,4H_2O$; they show, however, that the new compound is formed, as was the potassium compound, by 2 mols. ammonium taking the place of SO_2.

The vanadylic sulphate does not seem to combine, nor to decompose itself with sodium sulphate. The solutions of the two compounds remain clear after mixing. Evaporated in the cold, crystals of Glauber salts are separated, tinged intensely yellow by a small amount of vanadic acid. They were recognised as $Na_2SO_4,10H_2O$ by analysis and crystallographically. A solution of vanadylic sulphate is decomposed by sodium acetate under gradual formation of amorphous vanadic acid, and from the filtered and evaporated mother-liquor sodium sulphate of intensely yellow colour crystallises. Magnesium sulphate behaves with vanadylic sulphate like sodium sulphate. When sufficiently concentrated the solution of the mixed salts deposits the former in its original shape.

These results again demonstrate the great energy with which potassium unites with vanadium compounds. I have shown on a former occasion that ammonium vanadate contains potassium if precipitated from solutions containing potassium; that the vanadylous sulphates cannot be freed from potassium if such was present in the acid liquor in which they formed, and shall shortly demonstrate that the vanadid-sulphates, V_23SO_4 and $V_2H_24SO_4,2H_2O$, behave likewise.

Macclesfield, December, 1877.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Thursday, March 30, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

THE PRESIDENT in his Address, after referring to the general history of the Society during the last twelve months mentioned that the whole subject of the bye-laws had received the very careful attention of the Council. The verbal alterations recommended were very numerous, but the real alterations affected mainly the mode of electing Fellows and of appointing Auditors. The constitution of the Publication Committee has been entirely altered; it will for the future consist of six members in addition to

the five officers of the Society. Various arrangements have been made for expediting the publication of papers, and the editor has made a successful effort to bring the work of abstracting up to date. This has involved the printing of an extra number of the Journal, which is on the point of being issued. As the duties connected with abstraction are increasingly laborious the Society has determined to appoint a sub-editor, and has been fortunate in securing the services of Mr. C. E. Groves for the post. The "Research Fund" now amounts to £4000, already: two papers, resulting from assistance rendered by its means, have been received, viz., "On some Points in Chemical Dynamics," by Dr. Wright and Mr. Luff, and "On Certain Polyiodides," by Mr. G. S. Johnson. It is to be hoped that many other chemists, especially those to whom the pursuit of chemistry has become a source of wealth, will contribute handsomely to this important fund. Since the last Anniversary Meeting an independent institute of professional chemists has been formed and has been incorporated (October 2) under the title of the "Institute of Chemistry of Great Britain and Ireland," with the two following objects: (*a.*) "To promote and encourage a thorough study of chemistry, and all branches of science allied thereto, in their application to the arts, to agriculture, to public health, and to technical industry." (*b.*) "To adopt such measures as may be necessary for the advancement of the profession of chemistry, and particularly for the maintenance of the profession of the consulting and analytical chemist on a sound and satisfactory basis." It will thus be seen that the two societies are perfectly distinct, but may be mutually helpful; the President therefore wishes all prosperity to the new institute. Sixty-five papers have been read before the Society during the past year, and two lectures have been delivered. There are at present 965 Fellows; 49 have been elected during the past year. The Society has lost by death one eminent foreign member, M. Regnault, whose name is so well known by his researches on specific heat, &c., as well as R. Apjohn, late Prælector of Chemistry in Caius College, Cambridge, who died in his thirtieth year from the results of a fall from a bicycle; J. J. Griffin, the founder of the well known firm of chemical instrument makers; W. Gossage, alkali and soap manufacturer; T. Hall, late science master at the City of London School; E. L. Koch, M. Murphy, Dr. H. M. Noad, late Professor of Chemistry at St. George's Hospital, author of a "Manual of Electricity"; E. F. Teschemacher, of the firm of Denham Smith and Teschemacher.

A vote of thanks to the President for his able address was proposed by Mr. DE LA RUE.

Dr. FRANKLAND, in seconding the vote, referred to the establishment of the Institute, stating that he was at first anxious to have it founded in connection with the Chemical Society; this was found, however, to be impossible; and he was at one time afraid that a separate body might injure the interests of the Society; he was glad to say that his fears were groundless, and he had every reason to believe that the founding of the Institute would furnish the Society with many welcome Fellows.

The vote of thanks was put and carried.

The PRESIDENT, in returning thanks, said that he had endeavoured to do his best for the Society, and thanked the Members of Council, the Officers, and Fellows for their constant and unremitting kindness to himself.

The Treasurer, Dr. RUSSELL, then gave a statement as to the condition of the Research Fund. At the conclusion of the report it was announced that Mr. De la Rue had offered the sum of £100 to be given to the Research Fund on the condition that it was to be devoted to any one important research.

A vote of thanks to the Treasurer for his report and to Mr. De la Rue for his handsome donation was proposed by Dr. ODLING, seconded by Mr. NEISON, and carried unanimously.

The TREASURER then read his Report of the condition of the funds of the Chemical Society.

A vote of thanks to the Treasurer for his lucid and satisfactory statements was proposed by Mr. ABEL, seconded by Mr. E. RILEY, and carried unanimously.

Dr. ODLING then rose to move that the Report of the President be received.

Mr. NEISON, in seconding the motion, referred to the want of reagents in the Preparation Room, and the desirability of distributing the General Index of papers to all Fellows free of charge; he also made some remarks as to the present mode of electing and admitting Fellows.

In reply, Dr. RUSSELL said that there had been no demand for reagents, but if such a demand did arise there would be no difficulty in supplying them.

Dr. ARMSTRONG said that he always made a point of communicating, if possible, with authors so as to have any thing they might want ready for their use.

Mr. CROOKES then proposed a vote of thanks to Mr. Watts, "our talented and conscientious editor."

Mr. HOWARD seconded the vote, which was carried unanimously.

Before electing the Council, &c., Dr. ODLING asked the Secretary for information as to an alternative, which he ventured to designate an opposition, list which had been circulated; it was such an exact copy of the list issued by the Council that many Fellows thought that both lists had come from the same source.

Dr. ARMSTONG replied that the persons issuing the list were unknown to him.

Mr. RILEY thought that the name of the Fellow who issued the list ought to have been attached to it to prevent mistakes.

Mr. NEISON said that he had issued the list on his own responsibility, and that he much regretted if any one had been deceived by it. He thought, as he had proposed Mr. Kingzett at the last meeting, that every one would have known where the list came from; besides, an additional name on the list would have rendered the balloting paper illegal.

The election of Officers was then proceeded with, Messrs. Beale and Thomson having been appointed scrutators. The following were elected:—

President—J. H. Gladstone, Ph.D., F.R.S.

Vice-Presidents—F. A. Abel, C.B., Sir B. C. Brodie, W. De la Rue, E. Frankland, A. W. Hofmann, W. Odling, Lyon Playfair, A. W. Williamson, T. Andrews, W. Crookes, F. Field, N. S. Maskelyne, H. E. Roscoe, R. Angus Smith.

Secretaries—W. H. Perkin, H. E. Armstrong.

Foreign Secretary—.Hugo Müller.

Treasurer—W. J. Russell.

Council—Lowthian Bell, M. Carteighe, A. H. Church, W. N. Hartley, C. W. Heaton, D. Howard, G. Matthey, E. Riley, W. A. Tilden, R. V. Tuson, R. Warington, C. R. A. Wright.

The meeting then passed the bye-laws as amended by the Council with a few verbal alterations.

PHYSICAL SOCIETY.

March 30, 1878.

Professor W. G. ADAMS, President, in the Chair.

THE following candidates were elected members of the Society:—S. Bidwell, M.A., LL.B., W. Grant, E. Gurney, and J. H. Smith.

Mr. W. H. PREECE described Byrne's Pneumatic Battery, and exhibited some of the results that may be obtained by its means. It is especially devised with a view to provide the medical profession with a portable battery capable of producing a considerable amount of heat, as is required for cauterising operations. The negative plate consists of a very thin plate of platinum, to which a lead backing is soldered, and this is covered with a sheet of thick copper, also coated with lead, the whole being then covered with a non-conducting varnish, with

the exception of the exposed platinum plate. Such an arrangement is found to be advantageous in that it increases the conductivity of the negative plate. Two of these plates are arranged to face the zinc plate, as in Wollaston's form of cell, and the exciting liquid consists of 12 ozs. of bichromate of potash, 1 pint of sulphuric acid, and 5 pints of water. By using such a mixture the sulphuric acid attacks the zinc, and the three atoms of very loosely-combined oxygen exercise a depolarising effect, by absorbing the evolved hydrogen. A fine tube dips into the exciting liquid, and is so arranged that it conducts a current of air from a small pair of bellows against the face of the negative plate. By this means any bubbles of hydrogen are, as it were, brushed off, and the current obtained from a given electromotive force is materially augmented, since the resistance is diminished. Mr. Preece then referred to several old forms of battery in which such an agitating principle is introduced, notably those of Grenet, Chitaux, and Camacho, and he went on to describe a series of experiments he has made with a view to ascertain the cause of the great heating and illuminating effects that could be obtained with the apparatus exhibited. He showed that the effects were due to the mechanical agitation of the liquid on the face of the negative plate, but whether the great production of heat in the battery and the great lowering of its internal resistance were chemical, thermal, or electrical effects remains for further investigation. By means of a small battery of four cells, in which the plates were 4 ins. by 2 ins., a length of 6 ins. of platinumwire, No. 18 (0·05 in.), could be heated to bright redness, and much more powerful effects were obtained by a large battery of ten cells made by Ladd. In this case about 2 feet of a No. 14 (0·089 in.) wire were heated, and it was shown that when connected with an 18-inch inductorium, kindly lent by Mr. Spottiswoode, sparks of over 17 inches could be obtained, but this length was reduced to about 8 inches on stopping the current of air. A similar effect was also very marked when the poles were connected with two carbon points, the light given out when the air-current was introduced being remarkably bright and steady.

Mr. Preece then exhibited an ingenious method of showing the vibrations of a telephone-plate to an audience, which has been devised by Mr. H. Edmunds. A vibrating plate is employed to break contact, as in Reiss's original telephone, and is introduced into the primary circuit of a small induction coil. The induced current is employed to illuminate a rapidly rotating Gassiot's tube, and on making and breaking contact by speaking into the resonator, an illuminated star is observed, the number of whose arms varies with the pitch of the note: with a very low note it may resolve itself into a single straight line.

Lord Rayleigh exhibited and explained an arrangement which he has employed with advantage in certain acoustical experiments in order to secure absolute uniformity in the rate of rotation of an axle. After referring to the mathematical principles involved in such a problem, he explained that the only hope of its solution lay in the employment of a vibratory movement, which by some suitable device must be converted into a motion of rotation. The axle whose motion it is required to maintain uniform is usually driven, at an approximately uniform rate, by means of a small horizontal water-wheel, or in some cases the electro-magnetic regulating apparatus presently described is sufficient by itself to supply the necessary power. At equal distances round the axle are arranged four soft iron armatures, which successively come in front of the poles of a horse-shoe electro-magnet placed in the circuit of a four-cell Grove's battery. The current is rendered intermittent by the following arrangement:—Passing into the body of a tuning-fork, vibrating about 40 times per second, it leaves by a small platinum stud, which is touched at each vibration of the fork. The current then traverses a second small electro-magnet between the prongs, and by this means the vibrations are maintained: passing to the magnet above referred to the current then returns to the battery. The velocity of the axle is such that it performs about one complete revolution for every four vibrations of the fork, and the exact adjustment is effected as follows:—If the driving power be just sufficient to produce the desired speed, the armatures will be so attracted by the magnet as to be exactly opposite to it at the middle of its period of magnetisation; and so long as this position is maintained the magnet will not (on the whole) affect it; but if a disturbance occur in the driving-power the armature will be displaced from its former position, and will be attracted by the magnet until the error is compensated. Besides the armatures, this axle also carries, concentric with it, a hollow metallic ring filled with water, and, as this possesses a certain momentum in virtue of its rotation, it will act as a drag, tending to check the velocity in case it increases, and in the converse manner when a diminution occurs. A blackened disk, perforated with rings of holes of various numbers, also rotates with the axle, and by placing the eye behind the ring of *four* holes, and observing a prong of the fork, it is easy to ascertain whether the uniformity is maintained, since in that case the prong will appear to remain stationary.

CORRESPONDENCE.

CHEMISTS AND CHEMISTS.

To the Editor of the Chemical News.

Sir,—Your readers must, I am sure, thank me for having stimulated Professor Attfield to justify my respect for his authority; and I am bound in all seriousness to admit that he has made out a case sufficiently strong at any rate to show that in regard to degree of credulity I am less well entitled than I thought to the designation of

A Credulous Chemist.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—As a provincial Fellow of the Chemical Society, I wish to draw your attention to what seems a grave defect in the mode of election of the Council. It may or may not be desirable that the Council should recommend to the society a list of members for election, but to practically enforce their acceptance offends all our political instincts. I can hardly suppose that the bye-law of the society, of which a printed copy is sent with the voting papers, is designedly contrived to render the Council self-elective, but it is impossible to doubt that this is its actual result. It is true that any Fellow is at liberty to propose additional names, and that these nominations are to be read from the chair and publicly suspended in the Society's rooms. In a society, however, where a large majority of the members rarely attend the meetings, and where the elections are by voting papers, such a regulation is a mere travestie of fairness, while the names so proposed are excluded from the printed voting list. For the nominee of any unofficial member to have a chance of election it would be necessary to send a private circular to every Fellow; an undignified as well as an expensive proceeding.

I wish it to be understood that I have not the least objection to any member of the present Council, and many of its names are such as I must honour and respect, but its very excellence makes it the easier and more befitting for me to complain of what seems wrong in principle, without raising the suspicion of personal motive. I cannot but see that if the government of the society were to fall into the hands of any clique, incalculable mischief might be done before, under the present rule, the majority of the Fellows could take any effective action.—I am, &c.

Henry R. Procter.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 9, March 4, 1878.

Theory of the Telephone.—M. Th. du Moncel.—The vibratory plate of the recipient cannot merely be replaced by a very thick and massive armature without affecting the transmission of speech, but these vibratory plates may be formed of non-magnetic substances. The vibratory plate may even be totally suppressed without hindering the telephonic transmission provided the polar extremity of the magnet is placed close to the ear. Hence the vibrations which reproduce speech in the receiving telephone are principally produced by the metallic nucleus infolded by the coil. The vibratory plate serves merely to react for the production of induced currents when set in vibration by the voice, and by its reaction upon the polar extremity of the magnetic rod to reinforce the magnetic effects produced by the latter.

The Vibrations of Matter and the Waves of the Ether in Photo-Chemical Combinations.—M. Favé.—We may regard it as admissible, at least as a probable conjecture, that affinity ought to be exerted when bodies in apparent contact have accordant vibrations of a sufficient intensity to draw into one common movement elements hitherto separate. Whether the vibrations are infra-luminous or ultra-luminous, according to the position in the solar spectrum of the resulting ether-waves, they all share the property of determining chemical combinations by accordance when their *vis viva* has a sufficient intensity.

Investigation of the Atmospheric Resistance in the Torsion-Balance.—A. Cornu and J. B. Baille.—Not suitable for abstraction.

Influence of Electricity upon Evaporation.—M. Mascart.—The author has examined if the slow formation of vapours is modified by the influence of electrised bodies. A number of small evaporating capsules, communicating with the ground, and containing, some water and others moist earth, were placed beneath conductors kept in a constant electric state. The amount of evaporation was always increased beneath the conductors, whether the electricity was + or −, sometimes being even doubled.

Observations on Gallium.—MM. Lecoq de Boisbaudran and E. Jungfleisch.—Crystals of gallium are obtained by introducing into the metal, cooled to 10° or 15° below its point of fusion, a platinum wire supporting a portion of solid gallium. In three to ten seconds octahedra may be collected, scarcely modified at their summits by traces of the base *p*. If the crystals are not promptly withdrawn the metal becomes heated to near its point of fusion, the solidification is retarded, and the base *p* is developed so as to produce large tables. The crystals of gallium obtained, though brilliant, are hard to measure, their surfaces being slightly curved. Gallium is hard and scarcely malleable. It can be extended under the hammer, but it soon becomes brittle. It breaks in the direction of the crystalline cleavage on a shock, or if suddenly bent. The authors have only succeded in obtaining it in thin foil by fusion between hot plates of glass. After cooling and solidification the metal can be readily detached from the glass, especially under water. Notwithstanding its relatively great hardness it leaves distinct marks, of a bluish grey, upon paper. It preserves its lustre in a laboratory where the air is always loaded with acid vapours; it remains brilliant in boiled water, but tarnishes slowly in water containing air. When in a state of fusion it is of a white, like that of tin or silver. When crystallised gallium is thrown into hot water it crackles and lets bubbles of gas escape. Gallic oxide is soluble in ammonia to a considerable extent. The authors have prepared the anhydrous chloride, iodide, and bromide. In the cold chlorine attacks gallium briskly with a great evolution of heat. The product is scarcely yellowish and would probably be colourless in a state of absolute purity. It is crystalline, fusible between 70° and 76°, easily volatile and deliquescent. The action of bromine is less energetic, but it takes place in the cold and liberates heat. The properties of the bromide are very similar to those of the chloride. To obtain the iodide the aid of heat is necessary. The iodide readily retains traces of free iodine, and seems to undergo partial decomposition if heated too strongly.

Elastic Forces of Vapours given off by a Mixture of Two Liquids.—E. Duclaux.—Aqueous solutions of monatomic alcohols, in their distillation follow the law—

$$\frac{a}{\epsilon} = m\frac{a}{a+\epsilon};$$

a and ϵ being the volumes of alcohol and of water in the liquid heated, and a and ϵ the same volumes in the products of distillation.

Theory of the New Direct Vision Spectroscope.—M. Thollon.—Not adapted for abstraction.

Combustion of Gases.—P. Schützenberger.—An examination into the propagation of the combustion of gaseous mixtures in narrow tubes, and the circumstances by which it is influenced.

Two Allotropic Varieties of Magnetic Oxide of Iron.—H. Moissan.—Fe_3O_4, prepared at a low temperature by the calcination of hydrated magnetic oxide in an inert gas, has the specific gravity 4·86, is attacked by concentrated nitric acid, and is transfomred by roasting into ferric oxide. The magnetic oxide obtained at temperatures from 350° to 440° is not peroxidised on ignition in the air, is not attacked by nitric acid, and its specific gravity varies from 5 to 5·09.

Action of Boron Fluoride upon Anethol, and an Examination of the Hydrofluoride of Fluoride of Boron.—F. Landolph.—At ordinary temperatures anethol is instantly polymerised by the action of boron fluoride, but at the boiling-point the action is totally different yielding anisol, C_7H_8O, and a compound, $C_{11}H_{16}O$. The hydrofluoride of fluoboron, $BF_3,3HF$, is a limpid fluid which, in contact with moist air, is rapidly resolved into hydrofluoric and boric acids. Its vapour density (4 vols.) was found to be 4·79 or 4·65, theory indicating 4·42.

New Carbonated Cupric Liquid for the Determination of Glucose.—H. Pellet.—Pure crystalline copper sulphate, 68·70 grms.; Rochelle salt, 200·00 grms.; carbonate of soda, pure and dry, 100·00 grms.; chloride ammonium, 6·87 grms. These salts are mixed with 500 to 600 grms. of distilled water, dissolved in the water-bath, and made up to 1 litre, filtering if needful. 10 c.c. of this liquid = 0·05 grm. of sugar.

Lactic Fermentation.—L. Boutroux.—The author considers the lactic ferment and the *Mycoderma aceti* as one and the same organism, its functions varying with the composition of the putrescent medium.

Researches on the Chemical Composition and the Functions of the Leaves of Plants.—B. Corenwinder.—The author maintains that young leaves inspire oxygen and exhale carbonic acid, but as they reach maturity this diurnal expiration of carbonic acid ceases. This change is accompanied by a decrease in the relative amount of nitrogenous matter and of the phosphorus, which become less in quantity as the leaves grow older, whilst the lime increases. The function of the chlorophyll is to retain and decompose the carbonic acid given off in respiration.

Mineral Waters of Challes in Savoy.—E. Willm.—The springs in question are very rich in iodine and sulphur.

MEETINGS FOR THE WEEK.

MONDAY, April 8th.—Medical, 8.30.
—— London Institution, 5.
—— Royal Geographical, 8.30.
—— Society of Arts, 8. (Cantor Lectures). "Some Researches on Putrefactive Changes, and their Results in Relation to the Preservation of Animal Substances," Dr. B. W. Richardson.
TUESDAY 9th.—Civil Engineers, 8.
—— Royal Institution, 3. "Protoplasmic Theory of Life, and its Bearing on Physiology," Professor Garrod.
—— Photographic, 8.
—— Anthropological, 8.
WEDNESDAY, 3rd.—Society of Arts, 8. "A New Method for Producing Cheap Heating Gas for Domestic and Manufacturing Purposes," Mr. S. W. Davies.
THURSDAY, 11th.—Royal, 8.30.
—— Royal Institution, 3. "Chemistry of the Organic World," Prof. Dewar.
—— Royal Society Club, 6.30.
—— London Institution, 7.
—— Mathematical, 7.
FRIDAY 12th.—Royal Institution, 8. Weekly Meeting. "The Distribution of Plants in North America," Sir Joseph D. Hooker, 9.
—— Astronomical, 8.
—— Quekett Club, 8.
SATURDAY, 6th.—Royal Institution, 3. "On the Clavecinists of England, Italy, France, and Germany, and their Works," with Musical Illustrations on the Harpsichord and Pianoforte, Prof. Pauer.
—— Physical, 3.

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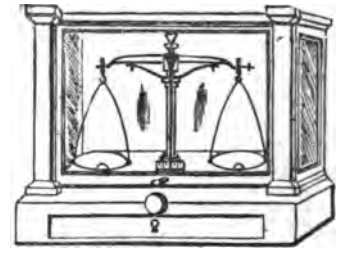
ROTTERDAM.  NEW YORK.

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 959.

ON DYER'S CHEMICALS.

By J. MARZELL.

(Continued from p. 107.)

PICRIC ACID [$C_6H_2OH(NO_2)_3$].

THE manufacture of picric acid from phenol is comparatively old, and intimately connected with the history of tar-distillation. The method stated by Laurent* in 1874 is still in use, in principle, and the only improvement in this way is the working up of the pure phenol.

Laurent made use of the whole tar. Later on only the fraction passing between 180° to 200° C. was taken, and now the purest market phenol is considered the only rational base for the picric acid manufacture (Crace-Calvert). A disagreeable point in working the pure acid was the very violent action of the nitric acid, and therefore the sulpho-compounds of the carbolic acid were taken as substitutes, either the free sulpho-acids,—

$$[P(SO_3H)x],$$

or their soda-salts, $[P(SO_3Na)x]$,† being brought into reaction with concentrated nitric acid.

Respecting the manufacture from the tar-oils, Quinon Ainé gives a report,‡ but in the present state of that industry it is of mere historical interest.

The picric acid has not been dislodged by the new dyes, and is still used in large quantities. Having a comparatively good market price its manufacture can lucratively be joined with the produce of pure carbolic acid, and therefore it might be of interest to describe in a few words the method of its manufacture.

Manufacturing Process.

As mentioned above, it consists in the reaction of concentrated nitric acid upon sulpho-compounds of phenol. To produce the sulpho-acids, equal parts of crystallised phenol and concentrated sulphuric acid of 1·843 sp. gr. are heated to about 100° C. till a sample taken out of the mass is completely soluble in water, hereby indicating the transferring of all the phenol into sulpho-compounds. Then the steam is shut off, and the whole allowed to cool down. In some works the sulpho-acids are now diluted in water, and therefore twice the quantity of water is added; a little steam supplied if needed. In other places it is preferred to take the concentrated acids directly into action. For forming the sulpho-acids: this operation either takes place in stone ballons standing in a steam-bath or in wooden tanks lined with lead, a system of steam-pipes lying on the bottom.

The action between the sulpho-compounds and the nitric acid is generally effected in stone ballons, similar to those used for the absorption of hydrochloric acid vapours in the soda works. The round cover is fastened air-tight during the reaction by means of any cement standing the acid. Of the two tubules one serves for carrying away the nitrous, &c., vapours, the other for supplying the sulpho-compounds. The ballons stand in a double line in a steam-bath. At a small distance above them two pipes run along, being joined with each pot by junctions. The one is the main-pipe for the nitrous, &c., vapours, and leads directly into the condensing apparatus; the other has to conduct the sulpho-acids. In the tubulus intended for this, a funnel is fastened air-tight, leading below the surface of the nitric acid in the pot. From the main pipe there are short pipes with cocks to each of these funnels, allowing the supply to be regulated as wanted. The concentrated nitric acid is put into the pot, and the sulpho-compounds are added slowly. It is of no advantage to hasten the operation, as in this case black resinous products are formed, with a considerable loss of the nitric acid, and causing great difficulty and annoyance in the purifying process.

The principal part of the reaction takes place without requiring any heat, and only at the end of the operation the steam is turned on, by which the action re-commences, and the last traces of unassailed crude products are oxidised. If there is not observed any further development of red nitrous vapours the steam is stopped, and the whole allowed to cool down.

I mentioned above that the sulpho-compounds are also taken without being diluted in water. In this case the reaction has to be moderated by stirring the mass whilst the operation goes on. The apparatus in use for this are analogous to those which have answered all demands in the nitrification of benzol, &c. They are cast-iron pots, with agitator driven by mechanical means, and different arrangements following the supply of the different materials, the carrying away of the arising vapours, and so on. Working in this way, the sulpho-compounds can be formed in the same pot, and then the nitric acid be supplied gradually into the concentrated mixture of $P(SO_3H)x$. The resulting picric acid forms an oily syrup-like mass, forming large and hard crystals in cooling. They are broken, isolated in a centrifugal machine or a filter, washed once or twice with cold water, and finally pressed. They are then diluted in boiling water, slightly acid (40 to 50 grms. of nitric acid per gallon of water generally taken), and allowed to crystallise.

Instead of that purifying by crystallising, it is often much preferred to convert the free acid into an alkali salt, to purify this, and to regain the pure and free acid by decomposing the same.

From the theoretical point of view the potassium salt would indisputably be preferred to the sodium salt. It is much more soluble than the latter, which, besides that, always takes into solution a part of the accompanying oily impurities. The worst difficulty—nearly insurmountable—in working on a large scale is the fact that the potassium salt, so very soluble in boiling water, separates as the liquor cools with an immense rapidity. That disagreeable quality causes much delay in the filtering process, as the precipitating crystals of picrate and potassium stop the pores of the filters and puts them out of work. By heating up the filters by means of indirect steam and different other expedients, trials were made to prevent that mischief, but none of them seemed to answer very well, and as the advantages are after all not so very great, the sodium salt is now adopted in nearly all works.

To convert the acid into soda salt, either the crystals are taken as they come out of the pots, or they are once re-crystallised out of acid water, as by this operation a part of the resinous by-products is already carried away. To get rid of all these impurities entirely, the soda is added in two portions. After having mixed the first part of the alkali to the hot solution of picric acid, it is filtered or digested from the impurities whilst hot. (The oily bodies are not yet diluted in the still acid liquid.) After this the rest of the soda is supplied to the filtrate. The alkali has to be taken in excess, as the picrate of soda is nearly insoluble in the alkaline solution, and therefore separates nearly theoretically.

The picrate of soda is gathered, pressed, washed with cold water, then diluted in boiling water, and over-saturated with sulphuric acid. The picric acid is precipitated, and precipitates nearly entirely, as it is insoluble in the mother-liquor containing the acid modification of sulphate of soda ($NaHSO_4$).

Many experiments have been made on purpose to replace

* *Ann. Chem. et de Phys.*, [3], iii., 221.

† "Rapports de la Jury, International, Paris, 1867," tome vii., Class 48, p. 280.

‡ *Mem. de la Soc. d'Agr. a Lyon*, 1849.

the alkalies by lime; but the results have not proved satisfactory:—

(1.) The basic lime salt formed—

$$C_6H_2(NO_2)_3O\diagdown Ca$$
$$C_6H_2(NO_2)_3O\diagup$$

is scarcely soluble. Of course that could be overcome by not saturating entirely, or by adding a certain quantity of free picric acid in filtering.

(2.) The sulphuric acid cannot be taken any more for decomposition, as the sulphate of soda ($CaSO_4$) formed would precipitate and mix with the settling picric acid, which would again be in contact with the impure mother-liquors. This point is the greatest difficulty. Only nitric and hydrochloric acid, therefore, could be taken in view of their forming salts soluble in water. But both these acids take not by any means unimportant quantities of picric acid into solution, rendering so illusory all advantage which was expected of the difference in price between the crude materials. Concentrated sulphuric acid of 1·843 sp. gr. also keeps a small quantity diluted; but by adding 2 to 3 volumes of water the picric acid is precipitated entirely. Weak H_2SO_4 (proportion 1 : 11) does not dilute any picric acid.

For recognising picric acid the following comparing reactions may be of use (L. Kopp):—

With NaOH, colours yellower.
With $SnCl_2$, in boiling, slight yellowish precipitate.
With Fe_2Cl_6, golden-yellow precipitate.
With NaSH, yellowish red; boiling, dark reddish yellow; concentrated, blood-red.
With Am_2S, like with NaSH.
With $CaOCl_2$, sometimes white, turbid.
With KCN, yellow-red; concentrated, blood-red.

Examination.

With the picric acid of commerce very often impurities are mixed, proceeding either from the process or added purposely as adulteration. They can easily be found out by taking advantage of the difference in qualities between them and the picric acid.

(1.) *Resinous Substances.*—They generally come from the picric acid process, but nevertheless they very seldom amount to more than 0·03 to 0·05 per cent; they are only noxious in the dyeing-bath. To separate them, 5 grms. of picric acid are diluted in hot water, a drop of sulphuric acid is added, and filtered. The resinous and oily impurities remain in the filter.

(2.) *Oxalic Acid.*—It is very possible that small quantities of this arise from the process, as that body is easily formed if the reaction of nitric acid is too violent or goes too far; and, as well, it can crystallise out with the picric acid and can escape an even very carefully conducted purifying. But if there are larger quantities found, an intentional adulteration can be concluded. The sample is diluted in hot water, some ammonia and a few drops of a solution of $CaCl_2$ are added. The formed oxalate of lime,—

$$COO\diagdown Ca,$$
$$COO\diagup$$

is gathered on a filter, dried at 100° C., and weighed. 100 parts of oxalate of lime will answer to 69·7 parts of pure oxalic acid.

(3.) *Saltpetre.*—Can arise from the process, especially if the water used for re-crystallisation was acidified with nitric acid instead of sulphuric acid; but generally it is put in purposely. It can easily be separated, as it is not at all soluble in strong alcohol. 5 grms. of picric acid are digested with about 50 grms. of absolute alcohol. The residue is gathered on a filter, and washed with alcohol till the filtrate is absolutely colourless. The residue on the filter is dried at 100° C., and weighed. To examine it properly for NO_3Na an analysis would be wanted, but generally it is enough to know the quantity of impurities, and never mind their theoretical composition. A special test for saltpetre or nitric salts in general is when the body in question, put upon red-hot coals, detonates, of which fact advantage can easily be taken here.

(4.) *Sulphate of Soda.*—It is detected in the same way as the foregoing. An approximate test upon H_2SO_4 can be made in adding a solution of hydrochlorate or nitrate of baryta, which causes a precipitate.

(5.) *Sugar.*—The sample is diluted in boiling water, saturated with carbonate of potassium, evaporated to dryness on the water-bath, and the sugar extracted from the residue by means of alcohol. The usual method of sugar testing is of not much use here, as the picric acid itself is altered by reducing agents. To separate the picric acid from the whole lot of impurities, and to see the percentage of the pure body easily, J. Casthelaz* constructed an apparatus, which he calls Picrometer. The sample is put into a graduated cylinder and shaken with ether, which only dissolves out the picric acid, so that the remaining impurities can easily be made out. M. Moyret† proposes to take benzol instead of ether, which is generally accepted now. But in this case it is good to hold the cylinder in warm water, as the benzol does not dilute the picric acid so very easily.

ON

SOME SIMPLE LABORATORY MANIPULATIONS.

By Dr. P. TOWNSEND AUSTEN, F.C.S.,
Assistant Professor of Chemistry in Rutger's College.

THIRD PAPER.

As I see in the CHEMICAL NEWS (vol. xxxvi., p. 57) some allusions made to various forms of wash-bottles, I should like to mention how extremely useful I find a series of different sized jets. It would appear so self-evident that one would think everyone who used a wash-bottle would have a set; yet, indeed, I have known chemists to have a whole series of wash-bottles in order to throw different sized jets. These jets I keep in a division of a drawer. They can be changed in a moment.

Jets are best made by allowing the heated glass to close, until the right size of aperture is obtained. Drawing a tube is not to be recommended, since the stream of water it delivers is rarely round, and hence likely to spray. Moreover, such jets, when made fine, are extremely fragile.

A useful form of jet, and one that I have never seen, although I suppose the idea must have occurred to several, is made in the following manner:—Close the end of a glass tube of about 4 m.m. internal diameter and about 1 m.m. thickness, and blow a bulb about 1 c.m. in diameter. Then heat a platinum wire to a white heat in the flame of a blast-lamp. The flame should be about 5 c.m. long, and the heated spot about 1 c.m. from the end of the wire. By gently pressing the side of the bulb against the wire it is easily pierced. On withdrawing the wire slowly, and at the same time allowing it to cool very slightly (which is effected by holding it higher up in the flame), a small round hole is made in the side of the bulb. The size of the hole depends on the diameter of the wire, its temperature, and the rapidity with which it is withdrawn. The sharp edges are easily removed by carefully filing with a fine file moistened with caustic soda solution.

This form of jet has the advantage that it throws a powerful stream at right angles to the delivery-tube. I find it extremely useful in washing many precipitates, and particularly in dislodging particles adhering to the sides of a filter. It is also useful in washing down precipitates from inverted vessels. Its shape renders it very strong, there being no projecting points to break off.

A bulb-jet with three small holes, in the form of a tri-

* *Moniteur Scientifique*, 1866, 984.
† *Ibi* 1866, 1036.

angle in the bottom, will be found remarkably efficacious in washing down precipitates from deep inverted beakers, large test-tubes, &c. The streams must not diverge more than 1 c.m. at a distance of 30 c.m.

I have lately made my ordinary jets in this manner—having, however, only one hole in the bottom—since they are so much stronger. By holding the jet up for an instant after cessation of the blast, the liquid in the delivery-tube will run back into the flask, thus preventing the annoying dribble which accompanies a wash-bottle with a drawn jet.

For washing large amounts of substances, not intended for quantitative operations, I use a bulb-jet having a fine hole in the bottom, and four others, equidistant from each other, in the periphery of the bulb.* This jet I thrust deep down in the filter, and blow a strong blast of water until the liquid reaches the desired height.

Filter-Papers without Ash.

For many purposes such papers are extremely useful. There is nothing new I believe in the use of hydrofluoric acid for this purpose, but perhaps the following may be useful as a laboratory recipe:—

Ordinary white German filter-paper is cut in the desired form, and washed out with hydrochloric acid as usual. 30 c.c. of strong hydrochloric acid and 15 c.c. of commercial hydrofluoric acid are mixed together in a platinum dish, and diluted with water to 500 c.c. The papers are placed in the liquid, and allowed to remain for four or five days. The liquid is then poured off, and the filters washed with hot water. This is best done by pouring hot water on them, allowing it to remain about ten minutes, and then decanting. This is repeated until the washings have no longer an acid reaction. The papers are then placed in a porcelain dish, and washed with warm water until no hydrochloric acid can be detected in the washings; after which they are dried in an air-bath. Paper prepared in this manner gives no appreciable ash on incineration.

Infusorial Earth for Drying.

I may be pardoned for drawing attention to this remarkable absorbent. It has been used in technical operations in Germany, I believe, for several years, and now is gradually finding an introduction into the laboratories.

A wet filter-paper placed on a thin layer of it (5 to 10 m.m. thick) becomes only damp, in fact almost dry, in an incredibly short space of time. It far surpasses, in my opinion, porous plates and plaster of Paris slabs. It has also the advantage that by heating it becomes again ready for use. Manufacturers of the article claim that it absorbs six times its weight of water.

In cases where the substance and filter-paper are to be weighed it is only necessary to place the wet paper, with the substance on it, on a paper (or two) of somewhat greater diameter (10 c.m. greater diameter). This prevents any danger of the earth getting on to the first paper. Those precipitates which Bunsen burns on the wire while still damp, are ready for incineration after five or six minutes on the earth.

This remarkable absorptive power makes an excellent lecture illustration. Two filter-papers are dipped in water and exhibited. One is then placed in a thick layer of the earth, and firmly pressed. The adherent earth is then scraped from the paper by a stroke with a table-knife. The two papers are now shown side by side, and make a striking contrast.

New Pyrogenous Derivative of Tartaric Acid.—M. E. Bourgoin.—The product obtained, dipyrotartaric acetone, is a neutral body, very sparingly soluble in water, but soluble in alcohol, ether, sulphide of carbon and chloroform. Its odour is aromatic, and not unpleasant, and its specific gravity borders closely upon that of water.—*Comptes Rendus*, lxxxvi., No. 10.

* A bulb of this kind is also useful in delivering gases which are to be washed.

ON THE LOSS OF NITRE IN THE MANUFACTURE OF SULPHURIC ACID.

By EDWARD JACKSON.

In a recent number of the Chemical News, Mr. G. E. Davis gives an account of some interesting experiments he has made to determine the source of loss of nitre in the manufacture of sulphuric acid. May I ask Mr. Davis if he has made any attempts to ascertain if the quantity of nitrous acids in the outlets corresponds with the loss as determined by the oxidation of the As_2O_3 to As_2O_5?

About six or seven months ago I devised a method of estimating these nitrous acids in the outlets, which has been in daily use here ever since. The process I use for collecting the gases is that proposed by Mr. Mactear for collecting the sulphurous acids. The gases are drawn first through a series of tubes containing caustic potash, and then through another series of tubes containing permanganate, the latter made slightly acid with HCl.; indeed, I have tried the latter with and without the acid, and the result is practically the same. The rate at which the gases are drawn through the liquids is about one cubic foot every four hours. Each morning the tubes are collected, the caustic and permanganate solutions mixed, made very slightly acid with HCl, and boiled to decompose the permanganates. Should the solution smell of chlorine—this rarely happens, except when too much acid has been used—it is boiled until all smell of that gas disappears. It is now filtered, made up to a definite volume, and an aliquot part taken for determining the nitrates; the remaining portion is used for determing the sulphates. The method used for estimating the nitrates is that recommended by Dr. Lunge (Chemical News, vol. xxxvi., page 145). A few grains of fine piano-forte wire are dissolved in a small flask, fitted with a Bunsen's valve, sulphuric acid being used to effect solution. The nitrate solution is next added, and boiled to expel the N_2O_2, the unoxidised iron being determined by permanganate. The number of cubic feet of gases passing through the outlets is ascertained from the percentage of oxygen found in the residual gases, as proposed by Mr. Mactear (Chemical News, vol. xxxvi., p. 49.) By a simple arrangement, an average sample of the gases from the chambers is used for determining the percentage of oxygen.

Now, from the experiments conducted as above described, I am satisfied that while the oxidation of the arsenic may account for a portion of the loss, it will not account for the whole. Of course I do not expect to find in the outlets as much nitre, in the form of nitrous acids, as is used in the furnaces, but the difference between that found and that used is too great to be accounted for by waste, such as blowing out from the chambers, the small quantity which is run into the salt cake pans, &c.

During the whole of the time this testing for nitre has been going on, about 40 lbs. of nitre to the ton of stone have been used. The average quantity found in the outlets does not exceed one-third of that amount; nor is the quantity found regular. Thus, during the past week, the average quantity found does not exceed 4 lbs. per ton of stone, while, about a month ago the quantity found during one week exceeded the quantity used for that week. It is true the quantity used had to be slightly increased the next week, as the chambers were getting short of nitre, and the condensation of sulphurous acid was not so perfect.

We see, then, that the oxidation of the As_2O_3 to As_2O_5 does not account for the whole loss of the nitre. I have an idea in what direction to look for the difference, and have already performed some experiments with the subject of finding it, but as yet have not been successful. I shall follow up the subject as opportunity offers, and should I meet with success will communicate the result to the Chemical News.

Messrs. T. Adkins & Co. Laboratory
Smethwick, near Birmingham.

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.*

By H. CARRINGTON BOLTON, Ph.D.

(Concluded from p. 99).

DECOMPOSITION OF SILICATES BY ORGANIC ACIDS AND AMMONIUM FLUORIDE.

21. A hot concentrated solution of citric acid decomposes ammonium fluoride, setting hydrofluoric acid free; and if silicates are present, many of them dissolve with great facility. Those minerals which were hardly attacked by citric acid alone, viz.: olivine, wernerite, chondrodite, and prehnite, together with the following not previously examined, orthoclase, albite, labradorite, augite, diopside, hornblende, almandite, spodumene, kyanite, talc, and epidote, are more or less readily decomposed. Of the latter, albite, labradorite, and augite, dissolve quite freely, while epidote appears to be slightly attacked by citric acid alone.

That this method of attack must be conducted in platinum vessels, goes without saying; the silicon evolved as a fluoride may be detected by suspending a moistened glass rod in the vapours, causing a gelatinous precipitate. To obtain affirmative results, it is essential that the silicates should be in very fine powder; the common micas, muscovite and biotite, which are obtained in pulverulent form with great difficulty, appear to resist these reagents; and ripidolite is but slightly attacked, perhaps for the same reason.

Tourmaline decidedly resists the action of these reagents, as well as the fluorides, cryolite, and fluorite. Samarskite is not attacked.

It is hardly to be expected that this method of examining minerals will be serviceable in field work, but it may prove applicable to quantitative analysis.

SUMMARY OF RESULTS.

22. The results of this investigation establish the hitherto unrecorded fact that organic acids not only decompose a considerable number of minerals belonging to various groups, but they also possess a remarkable selective power as regards the degree of this decomposition; to make this selective property of citric acid evident, and at the same time to present a condensed recapitulation of its action on the ninety minerals examined, we have drawn up the annexed table. This table shows that citric acid alone divides minerals into eight groups: A, those which dissolve in the cold without evolution of gas; B, those which dissolve in the cold with liberation of carbonic anhydride; C, those which are decomposed in the cold with liberation of sulphureted hydrogen; D, those which dissolve in the hot acid without evolution of gas; E, those which dissolve in the hot acid with liberation of carbonic anhydride; F, those which dissolve in the boiling acid with liberation of sulphuretted hydrogen; G, those which are decomposed on boiling, with formation of gelatinous silica; H, those which are decomposed on boiling, with separation of silica in a slimy or a pulverulent form. To these eight groups we may add three more; I, those which are decomposed by boiling with citric acid and potassium nitrate; K, those which are decomposed by heating with citric acid and ammonium fluoride; and L, those which are not attacked by any of the preceding methods.

Under E fall five minerals, hausmannite, manganite, psilomelane, pyrolusite, and wad, which dissolve rapidly in hot citric acid and decompose it with liberation of carbonic anhydride. Advantage is taken of this reaction in the quantitative analysis of manganese dioxides.

Notwithstanding the sharpness of the reactions by which many of the minerals are characterised, we do not regard the annexed table as a scheme for their determina-

TABLE SHOWING THE BEHAVIOUR OF CERTAIN MINERALS WITH CITRIC ACID, ALONE AND WITH REAGENTS.

Decomposed (in Fine Powder) by a Solution of Citric Acid.										
In the Cold.			On Boiling.							
A. Without Evolution of Gas.	B. With Liberation of CO_2.	C. With Liberation of H_2S.	D. Without Evolution of Gas.	E. With Liberation of CO_2.	F. With liberation of H_2S.	G. With formation of a jelly, (SiO_2).	H. With Separation of SiO_2.	I. Decomposed by boiling with C+KNO_3.	K. Decomposed by heating with C+NH_4Fl.
Brucite	Calcite	Stibnite	Zincite	Magnesite	Bornite	Willemite	Wollastonite	Argentite	Olivine
Angelsite	Dolomite*	Galenite	Gypsum*	Siderite	Bournonite*	Datolite	Chrysolite	Chalcocite	Wernerite
Pyromorphite*	Ankerite*	Sphalerite	Apatite*	Pyrolusite†		Pectolite	Chondrodite*	Pyrite	Orthoclase
Vivianite	Gurgite	Pyrrhotite	Cuprite	Wad†		Calamine	Chrysocolla	Marcasite	Albite
	Rhodochrosite*		Limonite*	Hausmannite†		Natrolite	Prehnite*	Nicolite	Labradorite
	Smithsonite*			Manganite†			Apophyllite*	Smaltite	Augite
	Witherite			Psilomelane†			Rhodonite	Chalcopyrite	Diopside
	Strontianite						Analcite	Ullmannite	Hornblende
	Barytocalcite						Chabacite.	Arsenopyrite	Kyanite
	Cerussite						Stilbite	Tetrahedrite	Talc*
	Malachite						Serpentine	Uraninite	Spodumene*
	Azurite*						Chrysotile*		Almandite
			And those in A.	And those in B.	And those in C.		Retinalite		Epidote
							Deweylite	And those in F and C.	And those in G and H.

L. *Minerals not decomposed by the above reagents*:—Molybdenite, cinnabar; magnetite, hematite, chromite, franklinite; cryolite, fluorite; samarskite; muscovite, biotite, ripidolite, and tourmaline.

* Feebly attacked.

† The CO_2 evolved is derived from the citric acid.

N.B.—The gases evolved are examined with acetate of lead test-paper; the solutions with appropriate reagents.

* Read before the New York Academy of Sciences, April 30 1877.

tion, but merely as a general view of their behaviour. The special cases in which minerals may be distinguished have been mentioned previously.

Under L are found thirteen of the ninety minerals examined; perhaps some of these will yield to these methods of attack by varying slightly the means of application. It is possible also that some of them may be decomposed by heating with citric acid solution in sealed tubes under pressure; but this process of course is not applicable to field work.

23. The applications of the methods of examining minerals detailed in the preceding pages are, we believe, numerous and important. Many of the reactions are simple, quickly applied, characteristic, and sensitive; they may be used, as we have seen, in distinguishing minerals nearly related, and probably in separating minerals mingled in one specimen. The methods will in all probability find useful application in quantitative analysis, a point which we propose to test at some future time. We have already employed a solution of citric acid in the analysis of limestones, for the determination of carbonic anhydride by loss. The evolution of gas proceeds regularly and the limestone is completely decomposed; citric acid possesses an advantage over hydrochloric acid in being non-volatile. Experiments to test the accuracy of the method were made with well-dried precipitated carbonate of calcium, and gave results differing by two or three tenths from the theoretical percentage.

By using the non-volatile organic acids in microscopic work whenever applicable, possible injury to the metallic mountings may be avoided, and in certain cases characteristic phenomena may be observed.

The importance of the application of these methods to the examination of minerals and rocks *in the field* is evident. The testimony of various persons as to the practicability of blowpipe work and chemical work in the field differs greatly, some claiming that it is valuable and easily accomplished, and others that it is altogether impracticable. Professor Geikie, Director of the Geological Survey of Scotland, mentions as a valuable addition to the geologist's outfit, "a small bottle of weak hydrochloric acid, carried in a protecting wooden box or case, of use for testing carbonates;" and he quotes Sir William Logan as employing acid to test the material adhering to a "limestone spear," with which the underlying strata can be probed.*

We propose, therefore, the substitution of a stout pasteboard box, containing solid citric (or tartaric) acid, for the usual glass bottle of liquid hydrochloric acid, and the addition of potassium nitrite to the usual list of dry reagents contained in portable blowpipe cases. Since citric acid solution decomposes potassium nitrite in the cold, we can carry nitric acid practically in a solid form; hydropotassium sulphate, already in use, furnishes sulphuric acid in a solid state; and it only remains, therefore, to provide for hydrochloric acid. Our experiments have as yet failed to solve this problem directly; ammonium, sodium, and potassium chlorides appear to resist the action of the organic acids. Iodine, on the other hand, while much less powerful than chlorine, possesses similar properties, and will form a valuable addition to the list of dry reagents; in aqueous solution it attacks many sulphides, and gives rise to characteristic phenomena. Iodine water was employed as early as 1858, by Professor Henry Wurtz, to separate pyrrhotite from pyrite;† but he did not extend its use to the determination of minerals, a question which we are now engaged in studying, and which has already yielded very interesting results.

Citric acid, potassium nitrite, and iodine, then, added to the reagents in common use,—borax, sodium carbonate, potassium cyanide, ammonio-sodium phosphate, test-lead, tin, and an assortment of test-papers, including acetate of lead paper, together with as many of the solid reagents used in solutions as space will admit, would complete the outfit of *dry reagents* for *wet analysis* and for blowpiping.

A pocket case, made of lacquered tin, 20 c.m. long, 5 c.m. wide, and 2·3 c.m. deep, containing pasteboard boxes (pill-boxes) of citric acid, potassium nitrate, dried borax, and sodium carbonate, together with a few simple requisites for blowpipe work, has been used by the writer in short mineralogical excursions with great satisfaction. To carry on the examination with solutions, we are also provided with a pasteboard case, cylindrical in form, 14 c.m. long, containing five stout test-tubes, fitting one within another, like a nest of beakers; the interior tube is open at both ends, a cork inserted tightly in the centre of the tube divides it into two compartments, one of which is filled with pulverised citric acid and the other with potassium nitrite, to be subsequently dissolved in water obtained in the field. This simple arrangement, greatly economising space, will naturally suggest itself to all working mineralogists, and would scarcely be worth mentioning were not wet analysis commonly regarded as inpracticable in field work.

In proposing the use of organic acids in this connection, we are aware that they already occupy a place in the lists of "Special Reagents" contained in the larger treatises on Blowpipe Analysis. Plattner* mentions tartaric acid, but limits its use to the separation of yttria and zirconia (by ammonium sulphide); and he names oxalic acid as employed in the precipitation of lime and in the separation of iron and uranium from yttrium, cerium, and lanthanum. To remove the organic acids from this restricted use, and to accord to them a more important position in the list of reagents, is our aim.

Application to Geological Phenomena.

24. This newly developed power of the organic acids has undoubtedly an important bearing on the chemistry of geological changes: organic acids, resulting from the decomposition of vegetable and animal matter, demand recognition as powerful agents in the work of disintegration and consolidation.

Many of the results attributed to the imperfectly studied bodies, geic acid, $C_{20}H_{12}O_7$, humic acid, $C_{20}H_{12}O_6$, and ulmic acid, $C_{20}H_{14}O_6$†—as well at the oxidation products, crenic and appocrenic acids—are perhaps the silent work of a higher class of organic acids.

That such acids constitute ingredients of the soil is well established: "When the leaves of beets, tobacco, and other large-leaved plants, fall upon the soil, oxalic and malic acids may pass into it in considerable quantity. Falling fruits may give it citric, malic, and tartaric acids." "Formic, propionic, acetic, and butyric acids, or rather their salts, have been detected by Jongbloed and others in garden-earth. The latter are common products of fermentation, a process that goes on in the juices of plants that have become a part of the soil or of a compost."‡

How far these organic bodies assist in disintegrating rock material is largely a matter of conjecture; that they do exert considerable influence may be concluded from the existence in the soil of the ulmates, humates, apocrenates, and crenates of potash, soda, ammonia, lime, magnesia, iron, manganese, and alumina. We have, moreover, numerous instances of minerals containing organic acids in combination:

Berzelius and other chemists have remarked the occurrence in marshes of compounds of iron and organic acids, of undetermined composition. Prof. T. Sterry Hunt§ describes limonites containing from 12·5 to 15 per cent of humic acids; Dr. George A. Koenig,‖ in an

* Science Lectures at South Kensington: Outlines of Field Geology. 1877.

† *American Journal o Science*, (2), xxiv., 190.

* "Plattner's Manual," translated by Prof. H. B. Cornwall, third edition, pp. 53 and 54. 1875.

† Mulder, *Ann. Chem. Pharm.*, xxxvi., 243, 1840. Detmer ascribes to humic acid the formula $C_{80}H_{44}O_{37}$, and regards humic and ulmic acid as identical in composition. "Cf. Watts' Dict.," II. Suppl., 648.

‡ Prof. S. W. Johnson in "How Crops Feed." New York. 1870.

§ Geol. Canada, 1863, 510.

‖ *Proc. Acad. Nat. Sci.*, Philadelphia. 1876, p. 155.

investigation of the cause of the deep green colouration of amazon-stone from Pike's Peak, concludes that the colouring matter consists of some compound of iron with an organic acid, the nature of which he has not yet determined. Dr. Gideon E. Moore, in a paper on Cryptocallite, recently presented to the New York Academy of Sciences, refers to moresnetite containing iron combined with some organic acid. Forster* conjectures that the colour of smoky quartz is due to the presence of an organic substance containing carbon and nitrogen.

To these scattered notices may be added the small number of minerals, mentioned in Dana's "System of Mineralogy," of which organic acids form constituents:

Whewellite, calcium oxalate, occurring in small crystals on calcite.

Thierschite, another calcium oxalate, forming an opaline incrustation on the marble of the Parthenon at Athens. Its origin is attributed to the action of vegetation on marble.

Humboldtine, hydrous ferrous oxalate, forming an incrustation on brown coal.

Succinite, or amber, containing 2½ to 6 per cent succinic acid.

Mellite, or hydrous mellitate of alumina, containing 40 per cent of the organic acid.

Pigotite, a salt of alumina and mudescous acid (Johnston). Formed on granite by the action of wet vegetation.

To these belong also the peculiar minerals grouped by Dana under the name Acid Hydrocarbons, found in peat-bogs and in brown coal, and containing the ill-defined bodies, geoceric, georetinic, and butyro-limnodic acids.

25. The manner in which silicates are decomposed and silica rendered soluble for the use of the vegetable world has been a subject of much investigation. Friedel and Crafts,† in their remarkable researches on the ethers of silicic acid, and Friedel and Ladenburg,‡ in a paper on silico-propionic acid, have given a new insight into the functions of silica and its transformations in the organic kingdom. The reading of the latter paper before the French Academy of Sciences, June 27, 1870, excited a lively interest; the authors describe silico-propionic acid, $SiC_2H_5O_2H$, as a white amorphous body closely resembling silica, insoluble in water, and soluble in hot concentrated potassium hydrate. This communication drew from M. Paul Thénard§ a remarkable announcement with respect to the solvent power of nitro-humic acid‖ on silica; he stated in substance that the dark-coloured acids of the soil consist of a mixture of acids of the humic and nitro-humic series, which contain a notable amount of silica, the amount varying from 7·5 to 24 per cent; and he conjectures that acids of the "nitro-humic series form spontaneously in the soil at the expense of the humic acid, the ammonia of rain-water, nitrogen of the air, and of the silica pre-existing in the soil."

Dr. J. S. Newberry, in a private communication to the writer, describes the peculiar manner in which quartz pebbles found at Keyport, N.J., in a clay very rich in carbonaceous matters, are eroded. All the sharp angles on these pebbles have been rounded, and the surfaces are more or less deeply pitted, as if by some solvent. He has also observed other phenomena of similar character, which he conjectures should be ascribed to the action of organic acids.

These references would be incomplete without mention of the generalisations of Prof. Henry Wurtz, whose "Scheme of the Geogonic Migrations of Silica throughout the Kingdoms of Life,"* shows thoughtful study and novel views.

Taken as a whole, the information respecting the part played by organic acids in the changes taking place on the earth's surface, is but small: are we not justified in the belief that some of the reactions disclosed by our researches may in the hands of chemical geologists furnish material for generalisations of no small value?

Finally, we are conscious of having treated but a very small number of minerals, compared with those which remain to be studied; our aim has been to place the methods of examination on record, rather than to exhaust the resources of mineralogy.

We take pleasure in acknowledging the services of Mr. Edward W. Martin, a student in the Chemical Course at the School of Mines, who has kindly assisted us in a portion of these researches.

School of Mines, Columbia College, New York.

* *Pogg., Ann.*, cxliii., 173.
† *Bull. Soc. Chim.*, v., 174, 238 (1863).
‡ *Comptes Rendus*, lxx., 1407.
§ *Comptes Rendus*, lxx., 1412.
‖ In translating "*acide azhumique*" by the term "nitro-humic acid," we follow custom, but we are of the opinion that "azo-humic acid" would be more correct, since the word "nitro-humic" implies the existence of a "nitro" radical, NO_2.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 4, 1878.

Dr. J. H. Gladstone, F.R.S., President, in the Chair.

After the announcement of visitors, &c., the minutes of the last ordinary meeting and of the anniversary meeting were read and confirmed. The following certificates were read for the first time:—B. Gregory, A. E. Tucker, and T. Slinger. The under-mentioned gentlemen were balloted for and declared duly elected:—R. H. C. Nevile, R. H. Jude, T. H. Norton, A. K. Huntington, G. H. Rutter, S. S. O. Norris, J. Spencer, T. W. Drinkwater, A. N. Pearson, W. J. Macadam, W. A. H. Naylor, J. Tchermiac, M. Zingler, S. A. Goldschmidt.

Mr. H. C. Sorby, F.R.S., then delivered a lecture "*On the Application of the Microscope to some Special Branches of Chemistry.*" The lecturer stated that he felt himself placed in a difficult position; if he gave a full account of his subject he feared that every one would be wearied; if, on the other hand, he contented himself with a summary, he was afraid that he would not be understood. He did not propose to touch on the general use of the microscope for magnifying small crystals or examining the minute structure of larger ones, but to confine himself to an application of the microscope to certain branches of chemistry in which it had not hitherto been employed. He would therefore give a rough general sketch of this application, and dilate on subjects which were especially interesting to chemists. Lines and circles have long been looked at through doubly refracting media, such as Iceland spar, but, until lately, no one seems to have systematically studied the appearances which present themselves when appropriate objects are observed with a *microscope* through various crystalline substances. These appearances are quite different, because the object glass of the microscope collects the diverging rays, and we have new conditions. Dr. Royston Pigott described in 1876 (*Proceedings of the Royal Society*, xxiv, 393, and *Monthly Microscopical Journal*, xvi., 294) his refractometer. The principle made use of in this instrument was the increase of the focal length of the object glass of a microscope caused by looking through media of different refracting power. Dr. Royston Pigott measured this displacement by means of a micrometer screw, fixed under the stage in such a manner that it became unsuitable for its ordinary use. The author has succeeded in contriving an arrangement which, while it gives sufficient accuracy of measurement, allows the microscope to be used for general purposes.

* *American Chemist*, I 206.

Practically the application of this method is very simple. If an object be placed on the stage of a microscope and the focus adjusted accurately, on placing over the object a plate of some highly refracting substance the object will be invisible, and to bring it into focus the body of the microscope must be moved farther out. If this distance be "*d*" and the thickness of the plate be T, Royston Pigott has shewn that—

$$\mu, \text{ the index of refraction, } = \frac{T}{T-d}$$

Now this distance can be measured either by means of a scale and vernier attached to the body of the microscope, or by having the head of the screw which works the fine adjustment graduated. To take an example, suppose we wish to determine the refractive index of water. A small piece of barometer tube is firmly cemented to a glass slide, and the cell thus formed filled with water; the cell is then covered with a cover-glass, which must be larger than the tube, and its surface must be parallel with that of the glass slide. Suppose the apparent thickness of water, t (*i.e.*, $T-a$) = 0·2360 inch, whilst d=0·0790 inch, then—

$$u = \frac{0{\cdot}2360+0{\cdot}079}{0{\cdot}2360} = 1{\cdot}335.$$

A second determination gave 1·334. In order to determine T and *d* we proceed as follows:—First, to get T we focus to the upper surface (any dust or scratches will do for focussing) of the glass slide, and read off the position of the body of the microscope; then focus to the under surface of the cover-glass and read off. The difference between these two readings evidently gives us the thickness of the stratum of liquid, *i.e.*, T. Secondly, to obtain *d* the image of a grating or circle is formed under the cell by means of a condenser under the stage, and the microscope focussed to it. The cover-glass, cell, and slide are now placed on the stage so that the observer looks through the cover-glass and slide but not through the cell. The image is again focussed; the difference between this reading and the first gives the displacement due to the slide and cover-glass. The cell is now pushed over the image, and the latter focussed; the difference between this reading and the second gives the displacement due to the stratum of liquid, *i.e.*, *d*. A two-thirds inch objective and No. 2 eye-piece are usually employed. To obtain accurate measurements many precautions are necessary, but with care T and *d* can be determined to 1-1000th of an inch. Red light is employed. For small quantities of liquid the ordinary live box is most convenient. The author has determined the refractive index of water with a film 1-50th of an inch in thickness and obtained the number 1·338. In a similar way the refractive indices of solids can be determined, the only condition being that suitable slices be cut, which are transparent more or less, and whose surfaces are flat and parallel. If we look at the image of a grating, *i.e.*, two systems of lines at right angles to each other, through a plate, with flat parallel surfaces, of glass or any transparent mineral which has no double refraction, both systems of lines are seen at once. The image thus formed is said to be *unifocal*, and the index of refraction thus determined is that of an ordinary ray. If, however, the mineral possesses double refraction the phenomena presented may be totally different; the ordinary ray has the same properties and is strictly unifocal; but the characters of the extraordinary ray differ according as the section is cut perpendicular, oblique, or parallel to the principal axis. Let us take calcite as an example. If we examine the image of the grating through a section parallel to the axis when the extraordinary ray is alone transmitted, the ordinary ray being cut off by a Nicol's prism, it will be found that there are two points separated from one another by an interval somewhat more than one-eighth of the thickness of the section, at each of which, only *one* system of lines can be seen *at once*, *i.e.*, at one focus: only the lines, say, from right to left are visible; at the other, only those from top to bottom can be distinguished. The image is thus truly *bifocal*. If we examine a circular hole, furnished by an iris diaphragm, through a unifocal or a bifocal crystal respectively in the first case, the image is seen undistorted and well defined at one focus, whereas in the bifocal image there is no focal point at which the hole can be seen of its true size and shape; it is either drawn out into a long vertical band with curved ends, or a horizoutal band, or forms a large circle without any definition. Crystals like aragonite, which have two optical axes, have no ordinary ray and no permanently unifocal images, but two bifocal images. With such a crystal a circular hole is drawn out into a cross. The lecturer then showed in what direction such crystals must be cut in order to obtain their true indices of refraction. The forms taken by gratings and circles were illustrated by models, and by means of the latter it was demonstrated that it was possible to tell at a glance in what direction a mineral had been cut in order to furnish the section under observation. The lecturer then proceeded to explain the application of this method of observation to rock section, and showed how valuable and simple the process was for identifying minerals. Even with sections 1-500th inch in thickness and 1-100th inch diameter good results have been obtained. The sections must be flat, and have parallel sides. They can be examined loose or mounted in Canada balsam, the method of observation being very similar to that described above in the case of liquids. Thus, in the meteoric irons of Krasnojarsk and Rittarsgrün, a clear mineral was proved to be olivine, and the three indices were found to be—

Krasnojarsk	1·71	1·68	1·68
Rittarsgrün	1·70	1·68	1·66
Olivine	1·70	1·68	1·66

In some cases it is better to compare the index of refraction of the unknown mineral with that of a known mineral, *e.g.*, quartz which is lying close to it. With very black horn-blendes good results can be obtained by using very thin sections, although the mineral is in moderately thin sections quite opaque. As an instance of the marvellously delicate nature of the method, the lecturer gave the examination of a section of a dolerite from near Glasgow, 1-400th of an inch thick. In this extremely thin section a zeolite, probably analcime, labradorite, calcite, and augite, were identified with almost absolute certainty. In a similar way, in sections of shells of *Pinna*, 1-1000th of an inch thick, calcite was recognised; whilst in a section of the shell of *Haliotis tuberculata* arragonite was identified. In conclusion, the lecturer referred to the connection between the indices of refraction and chemical composition. The subject is beset with difficulties, principally from defective data, but some points come out clearly. The fluorides have low indices of refraction; all the zeolites have indices less than that of quartz. All the earthy carbonates, sulphates, and borates have indices between those of quartz and corundum. All minerals with an index greater than that of corundum are metallic or metalloidal. Sulphur and sulphides have indices above 2·000, and the arsenides above 2·500. A mineral containing calcium instead of the alkalies has a higher index, *e.g.*, adularia, 1·52; labradorite, 1·61. Again, a mineral containing iron has a higher index than one in which calcium is substituted for that metal. Thus in the lime garnet, μ=1·74; in the precious garnet, μ=1·79. The lecturer finished by stating that much information might be obtained in a very short time by a qualitative examination of a mineral, *e.g.*, whether it was unifocal or bifocal, &c. The principal appearances described above were illustrated by specimens exhibited by the lecturer.

The PRESIDENT said that he was struck with the great extension of power with which this beautiful research of Mr. Sorby had furnished us. Such good results seemed possible with even one drop of liquid.

Mr. DUFFY asked if the method had been applied to crystals, "raphides," or liquids in vegetable cells.

Mr. Sorby replied in the negative, and pointed out that the cell-walls would have to be perfectly flat in order to obtain results.

A hearty and unanimous vote of thanks was then given to Mr. Sorby for his elaborate and important communication, and the Society adjourned to April 18, when the following papers will be read:—"On Terpin and Terpinol," by Dr. W. A. Tilden; "The Poisonous Principle of *Urechites suberecta*," by J. Bowrey; "On the Temperature at which a few of the Alkaloids Sublime, as Determined by an Improved Method," by A. Wynter Blyth.

CORRESPONDENCE.

THE APPLICATION OF SONSTADT'S SOLUTION TO THE SEPARATION OF MINERALS FOR CHEMICAL ANALYSIS.

To the Editor of the Chemical News.

Sir,—I regret much that Mr. Sonstadt should imagine from my note on the above subject that I make any claim whatever with respect to the solution in question—than which nothing could be further from my intention—and fear he is a little too sensitive on that point; for, so far as I can see, I have simply followed Prof. Church in giving an example of how it can be successfully employed in the examination of minerals. The only difference is that Prof. Church, and indeed Mr. Sonstadt himself, appear to look upon the determination of gems and other minerals by their specific gravity alone as the most important use for it.

I wished simply to show that it was possible to collect by this means a sufficient quantity of a rare or finely diffused mineral from a mass of rock for analysis; and as I had not, and have not yet, heard of a specific case of such a practical application of the liquid to the purposes of chemical geology, I was anxious to make the process known to others who may also find it useful in the analysis of complex rocks, but many of whom probably, like myself, have not had an opportunity of seeing Mr. Sonstadt's original paper. (For I need not remind that gentleman that in these days of voluminous periodical scientific literature it is possible to overlook even an important paper.)

A mineral analysis, the material for which was obtained in this manner, may have been already published, but I have not seen it. Under these circumstances, I conceive that to refer to mine in such a qualified phrase as "perhaps the first" is not altogether unjustifiable, and until I hear of a previous one I shall beg leave to adhere to this surmise. To say that doing so lays claim to any part of Mr. Sonstadt's rights is much the same as if one of the many popular writers on the applications of the telephone were accused of trying to filch Mr. Bell's original ideas on that subject.

In conclusion, I can only hope that Mr. Sonstadt will, on reflection, feel as grateful to me for helping to bring his solution under the notice of geological chemists as I am to him for providing me with a liquid which has been, and I hope will again be, of the greatest use to me.—I am, &c.

Edward T. Hardman.

14, Hume-street, Dublin.
April 6, 1877.

MINERAL GROWTH.

To the Editor of the Chemical News.

Sir,—Allow me another word or two on this interesting subject. Since my last communication several of my recent *electrum-growths* have remarkably changed. But what I wish now to announce is, that I have observed an unmistakable tendency in some of the varied infantile shapes to assume definite isometric forms. In fact, three of them have crystallised *cubically* since the beginning of the present year. I may also mention that two *cube* electrum crystals have recently grown out of two hand specimens of Merioneth quartz, the surfaces of the quartz itself being (apparently) free of metallic sulphides, &c. I am inclined to think that recent inorganic growths of this kind may be very common, but I am not aware of such having been before observed and publicly recorded.—I am, &c.,

T. A. Readwin.

Liverpool, April 2, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 10, March 11, 1878.

Phenomena Connected with the Vision of Coloured Objects in Motion.—M. Chevreul.—The author announces his intention of putting forward three laws of the contrasts of colour: simultaneous contrast, successive contrast, and mixed contrast.

Relative Affinities and Reciprocal Displacements of Oxygen and the Halogens Combined with Metals.—M. Berthelot.—The comparative reactions of the halogens and of oxygen with the metals, the reciprocal displacements in particular between iodine and oxygen depend neither on the type nor on the formulæ of the compounds, atomic or otherwise. They depend on the quantities of heat liberated by the direct combination of the metals with each of the antagonist elements taken in equivalent weights. A knowledge of these quantities of heat suffices to foretell the nature, the peculiarities, and even the reversal of the reactions.

Vibrations of Matter and the Waves of the Ether in Chemical Combinations.—M. Favé.—The author sums up the hypotheses which he has employed in his former communications, namely:—The elements of ponderable matter execute incessantly short and rapid vibrations which elude human vision. These vibrations communicate their movement to the ether, forming in it waves proportional in length to the duration of the vibrations, and which are all propagated uniformly with the same speed. The waves of the ether intensify the vibrations of the bodies upon which they impinge whenever both are in accordance. The ether waves propagate themselves, meet, and cross, preserving each its individuality and its peculiar influence, each element of the ether obeying the resultant of the forces applied at the same moment upon each of its points. The ether waves, according to their length and intensity, and also according to the vibratory system of the bodies upon which they strike, produce either thermic, luminous, or chemical effects. These effects may be either separated, united, or combined two by two.

Industrial Applications of Electricity.—Th. du Moncel.—The author sums up a number of these applications, such as in silk-weaving and spinning, and in shuttles which have been very successful. Electricity also plays an important part in organs, pyrophones, metronomes, telephones of various kinds, printing and engraving machines, reading apparatus for the blind, thermometers, pyrometers, psychrometers, hygrometers, photometers, actinometers, sounding apparatus, &c. The most curious application, and that which engages most attention, is the electric light.

Variations of Terrestrial Magnetism.—M. Quet.—The author announces his intention of entering upon a mathematical investigation of this subject.

Determination of the Principal Section of Nicol Prisms in Polarising Apparatus.—L. Laurent.—This can, according to the author, be effected with simplicity and precision by illuminating the apparatus with yellow light and interposing, between the analyser and the polariser a diaphragm, one-half of which is covered with a slender layer of quartz parallel to the axis and of the thickness known as half a wave.

Chloride of Sulphur.—M. Isambert.—The author proves that there exists merely a single chloride of sulphur in which chlorine is dissolved at low temperatures in considerable proportion. But from the non-existence of higher chlorides in a free state we are not entitled to deny their existence in combination.

Substitution of Sulphur for Oxygen in the Fatty Series.—A. Dupré.—The reaction of phosphorus oxychloride and the stability of the lead-salt seem to prove the existence of sulpho-propionic acid, an opinion confirmed by the action of sulphuretted hydrogen upon the nitriles, a reaction which gives rise to the sulphuretted amides recently described by Bernthsen as thio-acetamid and thio-propionamid.

The Catechins.—Arm. Gautier.—In this paper the author examines the catechins of Gambir, which have been hitherto confounded with those of the catechus properly so-called. In this substance he distinguishes three distinct compounds—

A .. .. $C_{40}H_{38}O_{16}$
B .. .. $C_{42}H_{38}O_{16}$
C .. .. $C_{40}H_{38}O_{16}$

The first melts at about 204°, the second at 176°, and the third at 163°. The whole catechin group, whether obtained from catechu or gambir, are characterised by turning green with ferric salts and giving a fine rose colour when successively treated with potassio-tartrate of iron and borax.

Action of Boric Fluoride upon certain Organic Matters.—M. Fr. Landolph.—An equivalent of benzylic aldehyd at its boiling point combines directly with an equivalent of boric fluoride, forming a compound which crystallises readily in white, brilliant laminæ. Ethylen, under the influence of direct solar light, combines with boric fluoride, forming a liquid compound, having the composition C_2H_3,BF_2.

Acid of the Gastric Juice.—M. Ch. Ricket.—The hydrochloric acid of the gastric juice occurs combined with tyrosin, leucin, and perhaps with other analogous bodies. Hence the gastric juice contains in reality a salt, formed of a feeble base, derived from the albuminoid matters.

On Garnierite.—M. J. Garnier.—The author gives to this mineral the following formula—

$$(MgO,NiO)SiO_2+nHO.$$

Not only are other elements, chrome, cobalt, copper, alumina, iron, &c., accidentally present, but the combined water varies from 5 to 11 per cent; there is no definite ratio between the quantities of magnesia and of nickel oxide present, these bases replacing each other in every proportion.

Archives Neerlandaises des Sciences.
Tome xii., 2me Livraison.

Reduction of Levulose.—H. D. Kruseman.—The author's results show that the reduction of levulose and that of glucose give rise to the same hexatomic alcohol, mannite. Mr. Dewar's question, if the mannite obtained by Linneman in the reduction of inverted sugar may have been derived from levulose as well as from glucose, must therefore be answered in the affirmative.

Tome xii., 3me Livraison.

This issue contains no chemical matter.

Tome xii., 4me Livraison.

Researches on the Origin of the Carbon of Plants.—J. W. Moll.—Carbonic acid supplied in excess to any part of a plant, subterranean or aërial, cannot develop appreciable quantities of starch in a leaf, or portion of a leaf, organicaliy connected to such part and placed in a space containing no carbonic acid. Carbonic acid supplied in excess to any part of a plant, subterranean or aërial, cannot accelerate in an appreciable manner in any leaf, or portion of a leaf, organically connected with such part, the formation of starch which takes place in the open air. The carbonic acid which the roots of a plant meet with in the soil is not able, either to determine the formation of an appreciable quantity of starch in the leaves of this plant when they remain in air free from carbonic acid, or to appreciably accelerate the formation of starch which takes place under the influence of the air alone.

Tome xii., 5me Livraison.

Researches on the Theory of Flames.—R. A. Mees.—The author reviews the two rival theories of the luminosity of flame: that of Davy, which ascribes the light to the incandescence of solid particles, and the more recent view of Prof. Frankland, who traces it to incandescent gaseous particles. M. Mees considers that all the phenomena hitherto observed may be explained by Davy's theory as well, if not better than by that of Frankland. He has also arrived at experimental results from which it appears clearly that the flame of carburetted hydrogen differs essentially from the majority of other flames which he has studied, and which render it very probable that there are actually solid particles in this flame.

Influence of Pressure on the Temperature of the Maximum Density of Water.—J. D. van der Waals.—The temperature of the minimum volume of water is lower as the pressure increases.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 50, February, 1878.

Report Presented by M. Cloëz on Behalf of the Committee of Chemical Arts on the Methods for the Detection of the Presence of Alcohol in Mixtures Employed by M. Jacquemart.—The author states that the addition of wood-spirit to alcohol sold for manufacturing purposes at a reduced scale of duty is illusory, since it can be easily purified and sold as a beverage. To detect ethylic alcohol in mixtures M. Jacquemart uses the acid nitrates of mercury. If, when the reaction is at an end, a little ammonia is added a black precipitate is obtained, more or less intense, according to the quantity of alcohol present in the original liquid. Methylic alcohol treated in the same manner gives no black precipitate.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 8, February, 21, 1878.

Salt water is proposed as an agent for taking ink spots out of cotton goods.

Vegetable ivory is the name given by its inventor, M. Turpin, to caoutchouc hardened with magnesia.

It is proposed to extract formic acid and an especial oil, caloptine, from locusts and grasshoppers.

A new enemy to the vine has been recognised in the Anthragnosis, a species of fungus.

On the Telephone.—Prof. Du Bois-Reymond.—The author considers that the telephone possesses, as regards the physiology of language, an importance which has not yet been fully brought to light. The theory of the instru-

ment invokes no new principle, but what could not have been foreseen and what astonishes everyone is the energy with which the sounds are transmitted.

No. 9, February 28, 1878.

According to the *Journal d'Hygiène* a case of hydrophobia has been successfully treated by inhaling oxygen. The cure is said to have been performed by two Russian physicians, but the date and place are not given.

Reimann's Färber Zeitung, No. 9, 1878.

Picrammate of ammonia, accordin to Dolfuss, is prepared by mixing a solution of 50 grms. picric acid in 700 grms. alcohol with 250 grms. ammonia, and passing through it a current of sulphuretted hydrogen. After expulsion of the sulphuretted hydrogen and the ammonia by heat there remains a mass soluble in water and capable of dyeing orange shades.

No. 10, 1878.

This issue contains nothing of general interest.

MISCELLANEOUS.

The Royal Society.—The following are the fifteen candidates selected by the Council for election into the Royal Society:—J. G. Baker, F.L.S.; F. M. Balfour; Rev. T. G. Bonney, M.A., F.G.S.; J. H. Cotterill, M.A.; Sir W. Elliot, K.C.S.I.; Rev. W. Greenwell, M.A., F.S.A.; T. Hawksley, C.E.; J. Hopkinson, M.A.; J. H. Jackson, M.D., F.R.C.P.; Lord Lindsay, M.P., P.R.A.S.; S. Roberts, M.A.; E. A. Schäfer, M.R.C.S.; H. Sprengel, Ph.D.; G. J. Symons; C. S. Tomes, M.A.

Russian Scientific News.—M. Eltekoff has found a new method for the synthesis of hydrocarbons of the type $C_nH_{n_2}$. On heating amylene with methyl iodide and lead oxide to 215° in sealed tubes, hexylene and heptylene are formed according the reactions:—

$$C_5H_{10}+CH_3I-HI=C_6H_{12}$$
$$C_5H_{10}+2CH_3I-2HI=C_7H_{14}$$

The C_7H_{14} obtained yields pentamethylethol—

$$[C(CH_3)_3.C(CH_3)_2.HO]$$

with sulphuric acid.

M. Slouginoff recommends carbon for the preparation of polarisation elements, such electrodes in acidulated water have a sufficient polarisation (2·28 Dan.)

M. Barchevsky long since (as the author understands), proposed the use of small fluorspar-sticks, pointed at their ends, as a substitute for the carbon-sticks for the electric light. Indeed, this old invention is worth studying again, as in using fluorspar-sticks an electric light of a sufficient brightness is obtained with a battery of 6 to 8 Grove's elements.

M. Setchenoff has made some experiments on the absorption of carbonic acid by—

1. Dialysed albumen from eggs with sodium hydroxide.
2. Casein whey with sodium carbonate.

Experiments proved that the absorption of the carbonic acid by these substances answers to the formation of the bicarbonate. The determination of carbonates in the whey is possible only in its diffusates, and even then only approximately, as the whey cannot be perfectly liberated from the salts it contains by dialysis.

S. Kern, M.E.

St. Petersburg.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

February, 1878.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Clear	0·000	0·010	0·165	0·052	22·40	9·520	0·360	0·87	1·530	14·8	3·70
West Middlesex	Clear	0·000	0·009	0·159	0·063	21·40	9·940	0·420	0·87	1·600	13·7	3·30
Southwark and Vauxhall	Clear	0·000	0·009	0·150	0·049	21·90	9·340	0·500	0·87	1·500	14·3	3·30
Chelsea	Clear	0·001	0·009	0·165	0·052	21·40	9·250	0·390	0·87	1·500	14·3	3·30
Lambeth	Clear	0·001	0·009	0·165	0·045	23·60	9·520	0·420	0·87	1·500	14·8	3·70
Other Companies.												
Kent	Clear	0·000	0·003	0·315	0·003	28·40	10·840	0·680	1·37	2·830	18·8	6·50
New River	Clear	0·000	0·009	0·195	0·038	21·80	9·450	0·360	0·87	0·900	13·7	2·70
East London	Clear	0·000	0·009	0·135	0·066	24·90	9·530	0·640	1·08	1·930	15·9	4·20

The quantities of the several constituents are stated in grains per imperial gallon.

Note.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. Meymott Tidy, M.B

MEETINGS FOR THE WEEK.

Monday, April 15th.—Medical, 8.
Tuesday 16th.—Civil Engineers, 8.
—— Zoological, 8.30.
Wednesday, 17th.—Meteorological, 7.
—— Geological, 8.
Thursday, 18th.—Zoological, 4.
—— Chemical, 8. "On Terpin and Terpinol," Dr. W. A. Tilden. "On the Poisonous Principle of Urechites Suberecta," J. Bowrey. "On the Temperature at which a few of the Alkaloids Sublime as Determined by an Improved Method," A. Wynter Blyth.

NOTES AND QUERIES.

Yolk of Eggs.—Can any of your readers inform me whether the yolk of the egg is employed as a dye colour in calico printing, or is otherwise used in the arts? The oil of the yolk is employed in Russia in soap making. Has it any other commercial use, and how is it obtained from the yolk?—F.J.S.

Manufacture of the Salts of Ammonia.—Will any of your correspondents please inform me the best book published on the manufacture of the salts of ammonia (recent), also the best practical treatise on tar distilling.—C.H.

THE CHEMICAL NEWS.

VOL. XXXVII. No. 960.

NITRIC ACID IN THE VITRIOL MANUFACTURE.

By GEORGE E. DAVIS.*

IT is well known that nitric acid in the form of nitrate of soda is largely used in the vitriol manufacture; but why it should be so largely used when nearly every works of repute has a tower or towers for the absorption of once used nitrogen compounds is a mystery to many. Is the loss simply one of manipulation which could be prevented by better machinery or better working? or is there some process of destruction at work, by which the nitrogen compounds are rendered inactive or incapable of being taken up by the absorbing acid?

Many theories have been advanced upon this subject, and the pet theory of many workers in this field has been the reduction of the nitrogen compounds to nitrogen monoxide or even to nitrogen by contact with the hot gases from the pyrites burners.

Unfortunately for these theorists, this was avoided in one works with which I was connected by the introduction of the nitrogen compounds into the cooled gas, and I may say that the consumption of nitre at these works was a little in excess (if any) of the general average.

The loss of nitrogen compounds by reduction to nitrogen monoxide or to nitrogen must be very small indeed, as you will see by the results in a further portion of this paper, and I shall proceed to show that with the present system of working it is nearly impossible to produce vitriol profitably with towers with less than one ton of nitrate of soda for every 100 tons of pyrites burnt.

For in the Glover's tower there takes place between the nitrous vitriol and the gaseous sulphur dioxide, a reaction, by means of which the nitrogen compound is liberated, and immediately reduced to N_2O_2, and as such enters the chambers. The arsenic acid which is present in the nitrosulphuric acid is at the same time reduced to arsenious acid, and as such leaves the concentrating or denitrating column.

In the Gay-Lussac or absorbing column another reaction takes place which causes nearly the whole loss of nitre. The strong acid which is run down this tower for the purpose of absorbing the nitrogen compounds contains arsenious acid, and by simply running down the tower comes out as arsenic acid. Now, wherever there is an oxidation there must be a reduction, except in the cases of elementary bodies being the active agents; in this case the arsenious acid becomes arsenic acid, the nitrogen trioxide becomes dioxide, which, being nearly insoluble in the strong vitriol, escapes from the tower. The amount of arsenious acid, then, which is put down the absorbing column is the measure of the limit of nitrate of soda which can be used.

It is easy to demonstrate the existence of this nitrogen dioxide in the escaping gases even when the exit is what is termed "sweet" and is colourless.

The exit gases when drawn through iodide of potassium solution liberate scarcely any iodine; but when drawn through a saturated solution of ferrous sulphate, the solution becomes brown and then black.

Having made a complete examination of vitriol exits of various kinds, I will lay them before you, and called A, B, C, D, E, F, G, not naming the works from which they were taken, while, at the same time, I may make a few remarks upon the working in each case, and mention anything which I think may contribute to explain the nitre losses.

The method used for the estimations in the following instances was:—A weighed quantity of *pure* caustic soda —or x c.c. of a normal solution, were placed in two aspiration bottles, with 20 c.c. of the strongest and purest obtainable hydrogen peroxide (free from H_2SO_4, HNO_3, HCl, and neutral when boiled); one cubic foot of the escaping gases was then drawn through the bottles when any sulphur compounds would form sulphate of soda, and the nitrogen compounds, from the dioxide upwards, would form nitrate of soda. The (1) acidimetric power was then taken, and the result calculated to grains per cubic foot of carbonate of soda neutralised by total acids; (2) the sulphuric acid was then precipitated (after acidifying), and weighed as barium sulphate, and calculated into grains of carbonate of soda, which that amount of sulphuric acid would neutralise. So the results are expressed as follow:—

(*a*) Grains of Na_2CO_3 neutralised by SO_3 from 1 cub. foot.
(*b*) " " " " N_2O_3 "
(*c*) " " " " total acids "

The speed of the draught in each case was taken with a tube anemometer, and the readings compared with the theoretical head of air calculated from the readings of 2 columns of ether in a U tube, one end inserted into the flue, the other open to the air. In several cases (2) the oxygen was determined. The speed given is the average of methods employed.

The nitrogen trioxide in the vitriol was determined by the mercury method.

In entering upon the description of these investigations, it will be as well to proceed in series, and in regular order, first starting with:—

A. Six chambers, all in one series, exit from last chamber going direct to chimney; escape tests taken during one week, when exit was sulphurous. Working badly.

B. From same works, when working well. Exit straw colour.

C. Nine chambers worked in three threes. The three exits collected in one steam tower packed with coke. Inlet to tower, straw colour. Exit from tower to chimney colourless. Working well.

D. Brimstone acid works. Four chambers worked in one series; exit from last chamber going direct to chimney. Working well.

E. Eighty-four tons Mason's pyrites burnt per week with an average consumption over three months of 1·26 per cent nitre. Two Glover's towers, one Gay-Lussac. Six chambers in one set.

F. Fifty tons Rio Tinto ore burnt per week. One concentrating column and one absorber. Four chambers in one set.

G. Eighty tons Rio Tinto ore burnt per week. Two concentrating columns, and one absorbing column. Eight chambers working in one series.

A.

In this works it was at one time thought better to use 3·4 per cent nitre, and let a little (!) sulphur dioxide go therefore, as the exit was sulphurous, you will not be surprised at the amounts of SO_3.

(1.)	*a.*	44·2
	b.	2·2
	c.	46·4
(2.)	*a.*	35·8
	b.	2·6
	c.	38·4
(3.)	*a.*	84·0
	b.	1·8
	c.	85·8

* A Paper read before the Faraday Club.

(4.)	*a.*	17·0
	b.	2·2
	c.	19·2
Average one week.	*a.*	22·0
	b.	2·5 = 1·8 N_2O_3
	c.	24·5

Area of exit pipe from chambers, 1·227 sq. ft.
Speed of draught = 7·4 feet per sec.
Nitrate of soda used per week, 34·5 cwts., which at 95 per cent = 14·6 cwts. N_2O_3.

Now, as we have 1·8 grains nitrogen compounds calculated as N_2O_3, and knowing the area of flue and speed of draught, we get:—

$$\frac{604800 \times 1{\cdot}8 \times 1{\cdot}227 \times 7{\cdot}4}{7000 \times 112} = 12{\cdot}6 \text{ cwts. } N_2O_3$$

escaping per week.

50 tons per week of vitriol, 123° Tw., were run from the chambers, and as it was mostly run from No. 3 chamber on account of that acid being of greater sp. gr., a large quantity of N_2O_3 was carried out with the acid. The vitriol contained 0·126 per cent N_2O_3 = 1·26 cwts. in the week.

We can follow, then, the following losses per week in cwts.

Lost by exit from chambers ..	12·60 cwts.
„ in chamber acid	1·26 „
Unaccounted for	0·74 „
Total N_2O_3 used	14·60 cwts.

B.

The same works as A, exit flue enlarged, and more nitrate of soda used = 4·7 per cent. The exit contained:—

(1.)	*a.*	2·46
	b.	2·40
	c.	4·86
(2.)	*a.*	0·43
	b.	3·57
	c.	4·00
(3.)	*a.*	3·87
	b.	1·50
	c.	5·37
(4.)	*a.*	0·34
	b.	0·72
	c.	1·06
Average one week	*a.*	1·16
	b.	2·52 = 1·8 N_2O_3
	c.	3·68

Area of exit, 2·6 sq. ft.
Nitrate of soda used per week, 50 cwts., which, at 95 per cent = 21·2 cwts. N_2O_3.

Now, as we have again 1·8 grains nitrogen compounds per cb. ft., calculated as N_2O_3, we get:—
Taking quantity in cubic feet passing per second as 14—

$$\frac{604800 \times 14 \times 1{\cdot}8}{7000 \times 112} = 19{\cdot}4 \text{ cwts. } N_2O_3 \text{ per week.}$$

90 tons of vitriol at 123° Tw., run out of chambers per week containing 0·042 per cent N_2O_3 = 0·756 cwts. N_2O_3.
Following these figures we obtain—

Lost by exit from chambers ..	19·4 cwts.
„ in chamber acid	0·756 „
Unaccounted for	1·044 „
Total N_2O_3 used	21·200 cwts.

C.

This works producing well, had nine chambers, and doing only small work, they were arranged in three sets of three each. The exits from each set were collected and made to pass up a tower 5 feet sq. and thirty feet high filled with coke. Steam was admitted to this tower, and the acid trickling down ran out about 70° Tw. The gases were a straw-colour on entering this tower, but colourless upon leaving the top. The exit contained—

(1.)	*a.*	0·22
	b.	1·84
	c.	2·06
(2.)	*a.*	0·18
	b.	1·62
	c.	1·80
Average one week.	*a.*	0·22
	b.	1·50 = 1·07 N_2O_3
	c.	1·72

Area of exit, 0·834 sq. ft.
Speed of draught, 12 feet per second.

Therefore, volume in cubic feet passing per second would be 10, nitrate of soda used per week 28 cwts., which, at 95 per cent, would give 11·87 cwts. N_2O_3.

Then, $$\frac{604800 \times 10 \times 1{\cdot}07}{7000 \times 112} = 8{\cdot}24 \text{ cwts. } N_2O_3$$

45 tons of acid at 123° were run from the chambers (from all the nine), containing 0·3 per cent N_2O_3 = 2·7 cwts.
From these figures we get:—

Lost by exit from chambers ..	8·24 cwts.
„ in chamber acid	2·70 „
Unaccounted for	0·93 „
Total N_2O_3 used	11·87 cwts.

D.

A brimstone acid works. Four chambers using 20 cwts. nitrate of soda per week. The sulphurous acid entered No. 1 chamber, and passed from No. 4 to the chimney. I had only an opportunity of examining this exit twice; but the working of the chambers never varied much:—

(1.)	*a.*	0·82
	b.	2·20
	c.	3·02
(2.)	*a.*	1·14
	b.	2·00
	c.	3·14

Average of the two trials = 1·5 grains N_2O_3.
Area of exit flue, 1 sq. ft.
Speed of draught, 6·4 feet per second.
Cubic feet passing per week, 3870720.

Then, $$\frac{387072 \times 1{\cdot}5}{7000 \times 112} = 7{\cdot}4 \text{ cwts.}$$

The vitriol run from the chambers weekly was 40 tons at 123° Tw., containing 0·04 per cent. N_2O_3 = 0·32 cwts. N_2O_3.
From these figures we get—

Loss by exit from chambers ..	7 40 cwts.
„ in chamber acid	0·32 „
Unaccounted for	0·78 „
Total nitrate (N_2O_3) used ..	8·50 cwts.

E.

Works using Tharsis ore, six chambers in one series, two Glover towers, one Gay-Lussac tower. Working very well. The exit tests were:—

(1.)	*a.*	1·14
	b.	0·51
	c.	1·65
(2.)	*a.*	2·26
	b.	0·49
	c.	2·75

Average (*b.*) = 0·35 grain N_2O_3.
Area of exit flue, 4 sq. ft.
Speed of draught, 8·5 ft. per second.
Cubic feet passing per week, 20563200.

Nitrate of soda used per week, 21 cwts. = 8·925 cwts. N_2O_3. 140 tons o.v. per week run down the Gay-Lusssc tower, containing 0·35 per cent As_2O_3 = 9·8 cwts. As_2O_3 per week, and according to the equation—

$$As_2O_3 + 2N_2O_3 = As_2O_5 + 2N_2O_2.$$

9·8 cwts. As_2O_3 would reduce 7·52 cwts. N_2O_3 to N_2O_2.

The o.v. running from the concentrating towers contained traces only of nitrogen compounds.

Now, $$\frac{20563200 \times 0{\cdot}35}{7000 \times 112} = 9{\cdot}18 \text{ cwts. } N_2O_3.$$

From which we get the following numbers:—

Lost by formation of nitric oxide ..	7·520 cwts.
,, imperfect absorption	1·660 ,,
	9·180

Which gives an access of 0·255 cwts. N_2O_3, and points to the fact that the average escape was not so great as shown by the two foregoing tests.

F.

This vitriol plant was badly arranged. There were four chambers, one concentrator, and one absorber. The acid was not all run down the concentrator. The No. 1 chamber was higher than the others, and its acid was run into No. 2, which was often highly charged with nitre. A great deal of vitriol was run to the pans direct from the chambers, and an undue proportion of concentrator acid was used in the absorbing column. Having to do more than its share of work in the concentrator, the nitre was high, on account of the large amount of arsenious acid which it contained.

110 tons of o.v. were run down the concentrator per week, containing 0·7 per cent As_2O_3 = 15·4 cwts. As_2O_3 per week.

The area of the exit flue was 4·17 sq. ft.

The speed of the draught 12 ft. per second.

Cubic feet passing per week, 30240000.

O.V. run from chambers 100 tons at 123° Tw. containing 0·05 per cent N_2O_3 = 1 cwt. N_2O_3.

Now the 15·4 cwts. arsenious acid would reduce 11·82 cwts. N_2O_3.

The nitre used per week was 32 cwts. = 13·6 cwts. N_2O_3.

I have no exit tests upon which I can rely from these works, therefore I am obliged to sum up as follows:—

Lost by formation of As_2O_5	11·82 cwts.
Run away in chamber acid	1·00 ,,
Other losses	0·78 ,,
Total N_2O_3 used	13·60 cwts.

G.

The working of the chambers was very variable at these works. The chambers very old, and production not very good.

Area of exit flue, 5 sq. ft.

Speed of draught, 16 feet per second.

Cubic feet of gases passing per week, 48384000.

All the vitriol, without exception, run down the concentrating columns, and contained traces only of N_2O_3.

120 tons o.v. were run down the absorbing column per week, and contained 0·4 per cent As_2O_3 = 9·6 cwts. As_2O_3 per week.

Nitrate of soda used per week 42 cwts. = 17·8 cwts. N_2O_3.

Exit tests were:—

(1.)	*a.*	1·40
	b.	0·48
	c.	1·88
(2.)	*a.*	1·06
	b.	0·03
	c.	1·09
(3.)	*a.*	5·08
	b.	0·64
	c.	5·72
(4.)	*a.*	1·84
	b.	0·16
	c.	2·00

Average Na_2CO_3 neutralised by nitrogen compounds 0·33 = 0·23 grains N_2O_3.

The 9·6 cwts. As_2O_3 would reduce 7·3 cwts. N_2O_3.

Then, $$\frac{48384000 \times 0{\cdot}23}{7000 \times 112} = 14{\cdot}18 \text{ cwts. } N_2O_3.$$

We may, therefore, sum up as follows:—

N_2O_3 lost by As_2O_5	7·3 cwts.
,, imperfect absorption ..	6·88 ,,
Unaccounted for	3·62 ,,
Total N_2O_3 used	17·80 ,,

Upon looking back at these results, we find that where towers are not used (A, B, C, and D) the losses due to the escape of nitrous compounds from the chamber exit are:—

A.	86·3 per cent
B.	91·5 ,,
C.	69·4 ,,
D.	87·0 ,,

of all the nitrate used, and the percentages unaccounted for are—

A.	5·0 per cent
B.	4·9 ,,
C.	7·8 ,,
D.	9·1 ,,

upon the total nitrate used. A and B were very carefully watched, B over a long period, while C and D only occasionally watched.

With those works using towers, the results are very variable, E shows an excess. In F I caught the tower man dodging me when taking the exit tests; therefore have refrained from using any of the figures previously obtained. In G, there is a large amount unaccounted for, 20·3 per cent. These points want clearing up, and it may be worth while for some of the members of the club to work in this direction. In any circular process like the present, we can never expect to regain all the active material; but as this loss seems due to arsenic, I have constructed the following table from the data of E, F, and G, which shows in column 1 the number of cubic feet of air passing the exit per ton of o.v. at 123° Tw. per week. Column 2, per cent nitrate rendered useless by arsenic. Column 3, per cent run away in chamber acid. Column 4, disregarding all losses but those in column 2, contains the lowest per cent of nitrate of soda upon the pyrites burnt.

	1.	2.	3.	4.
E.	126933	81·9	traces	1·03
F.	302400	87·6	7·3	2·80
G.	336000	41·0	traces	1·13

Thus it will be seen that with the quantity of arsenic present in the vitriol, which was run down the absorbing columns in the instances E, F, and G, that the lowest percentage of nitrate of soda which could be used to keep the chambers nitrous was 1·03 per cent, 2·80, and 1·13 per cent respectively.

If we wish to use a lower percentage of nitrate of soda than this, we must use for absorbing an acid free from arsenious acid, and taking the figures obtained at works E, I do not see why the quantity of nitrate of soda used should not be brought down to 0·26 per cent upon the pyrites burnt, or to 2·91 lbs. of nitre per ton of o.v., made at 123° Tw.

I shall soon have an opportunity of testing the truth of my theories. I am now getting to work towers which will be supplied with sulphur acid free from arsenic, with several little self-acting arrangements to prevent loss o

nitre. In making the drawings for these towers I have made many experiments for my guidance which I cannot enter into now, but after I have got fully to work I shall have much pleasure in reading another paper before the members describing the construction of the plant, and giving the results of my working, so far as regards the nitre losses.

Barton Arcade, Manchester.
Feb. 20, 1878.

ACTION OF PERCHLORIDE OF IRON AND CONCENTRATED SULPHURIC ACID ON SOME OF THE BASES IN OPIUM.

By DAVID LINDO.

If a little codeia is placed in a small dry test-tube, dissolved in concentrated sulphuric acid *without* the aid of heat, and a drop of solution of perchloride of iron added; the latter will float on the surface of the mixture without giving rise to any characteristic colour; but on applying a gentle heat below the line of contact, and shaking the tube slightly, the fluid acquires an intense and magnificent blue colour, very similar to that produced by ammonia with salts of copper. The tube should not be more than one-fourth full. Morphia treated in the same way gives rise to an intense *indigo* blue colouration. Seen by candle light these colours appear violet.

On adding water to either of these solutions, the blue colour disappears. The fluid acquires a yellowish red colour, which is deeper with morphia than codeia.

I am not aware that these reactions have been noticed before. Want of material prevents me at present from trying the action of the test on the other opium bases.

Very small quantities of the alkaloids should be used in these experiments, or the colour will be so intense that the fluid will appear opaque, in which case, however, the addition of more concentrated sulphuric acid will render the tint apparent. The blue colour remains permanent for days if the fluids are kept in test-tubes, but gradually changes on the surface from absorption of moisture.

Falmouth, Jamaica,
March 7, 1878.

THE NEW METHOD OF WEIGHING PRECIPITATES.

By CHARLES W. FOLKARD.

The interesting paper on this subject, by Mr. Clark, in the CHEMICAL NEWS of March 15th, will probably be of much value, by drawing the attention of chemists to a rapid, though perhaps somewhat rough, method of analysis. In chemical works especially, a determination, accurate to within 2 or 3 per cent, and obtainable in an hour, is often of far greater value than a regular analysis requiring a day or two to effect.

In November last, having occasion to boil down and crystallise a salt, formed by a double decomposition, in which sulphate of lime was one of the products, and wishing to get a result as rapidly as possible, I *estimated* the quantity of soluble matter left in the sulphate of lime, instead of washing it and boiling down the washings. To my astonishment I found that the precipitate from which the solution had been decanted, contained $\frac{1}{4}$ of its weight of clear solution, and the indicated sp. gr. of hydrated sulphate of lime was about 13·0. Being very busy, this was not followed up, and indeed had slipped my memory, but the paper by Mr. Cross (CHEMICAL NEWS, vol. xxxvii., p. 116), in which he observed that the indicated sp. gr. of ferric hydrate was about 10, reminded me of my own experience in the matter.

As to Mr. Cross's suggestion that the specific volume of ferric hydrate is variable "under identical conditions," this, to my mind, is a very hard matter to receive. If the numbers obtained by Mr. Cross as the weight of water displaced by a known weight of ferric hydrate, decreased slightly on digestion, the fact might be explained by the gradual increase of density, which many substances experience, and which is probably connected with their easier solubility when freshly precipitated.

But there is afterwards an increase in the numbers which is totally inexplicable.

It should be noted, however, that 1° F. makes a difference of 0·01 grm. in 100 c.c. of water, and with ordinary thermometers and specific gravity bottles (even with thermometer stoppers), it would be very difficult indeed to obtain results within one or two ten-thousandths. This being granted, it will be seen that the differences observed by Mr. Cross with ferric hydrate are in at least half the number of cases within the limits of errors of experiment. With regard to the silver determination, it seems to show that for heavy and anhydrous substances, the process would be very useful, but it would obviously conduce to the accuracy of the results if, when a 50 c.c. sp. gr. bottle is used, 10 grms. or more (if not too bulky) of the substance be taken.

As to our ignorance of the sp. gr. of precipitates recently thrown down, it would merely be necessary to determine this under certain known conditions, by taking a weighed portion of pure substance in the same way that solution of bichromate or permanganate is standardised for iron estimations, by means of pure iron (which method, by the way, is the only reliable one, even when the reagent, *e.g.* bichromate, is sufficiently definite and stable to admit of making up the standard solution by an exact weight dissolved in a definite quantity of water.) It would also be necessary for accurate estimations by this method to know the weight of water contained by the sp. gr. bottle at several temperatures, say 55°, 60°, 65°, and 70° F. (or even at less intervals), for every one is aware that it is impossible to obtain exact results when the temperature of the liquid differs more than 2° or 3° F. from that of the surrounding air.

With a few obvious precautions of this nature, Mr. Clark's process cannot fail to be of great value where time is an object.

Ranelagh-road, Ealing, W.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 13, 1878.

Prof. R. B. CLIFTON, Vice-President, in the Chair.

The following candidates were elected Members of the Society:—W. Campbell, R. W. F. Harrison, Rev. T. N. Hutchinson, M.A., B. W. Richardson, M.B., F.R.S.

The SECRETARY read a paper by Messrs. J. NIXON and A. W. HEAVISIDE, describing their experiments on the mechanical transmission of speech through wires or other substances, to which Mr. Preece had referred at a previous meeting of the Society. After describing a number of experiments, in which metallic disks soldered on to the ends of the conducting-wires were employed, they went on to enumerate the more successful experiments, in which wooden disks were mainly employed. The first actual transmission of speech was effected by placing the belly of a violin against the receiving end of the wire, when every syllable spoken was distinctly audible. Very good results were obtained by employing mouth- and ear-pieces formed as in a telephone, the disk being replaced by thin wooden disks 6 inches in diameter, and a No. 4 wire was found to

be most satisfactory. On suspending a length of this wire in such a manner that it had no rigid attachments it was ascertained that 120 yards is the limit through which a conversation can be carried on.

CAPTAIN ABNEY, F.R.S., described the method he adopted for photographing the least refrangible end of the spectrum. He pointed out that it is impossible with the ordinary sensitive salts employed in the usual way to photograph further than the Fraünhofer line E, though by a preliminary exposure to light of a daguerreotype plate Draper was able to photograph beyond the extreme limit of visibility in the red end of the spectrum. This method, however, gave what is known as a reversed picture, the lights and shades being transposed, besides requiring a lengthened exposure. It enabled Becquerel to photograph the spectrum in its natural colours, and, later, St. Victor obtained coloured images of coloured cloths. The object of Captain Abney had been to obtain unreversed pictures of this portion of the spectrum: in other words, to obtain a compound that would be similarly sensitive to the red and the blue components of white light. Such a compound he had at last obtained by what he termed *weighting* silver bromide with resin, and now he obtains it by causing the molecules of silver bromide to weight themselves. He showed an ordinary bromide of silver plate, and the colour of the transmitted light was of a ruddy tint, showing absorption of the blue rays. Another film was shown, containing weighted bromide of silver, which transmitted blue light and absorbed the red. Photographic plates prepared with the latter compound he showed were sensitive to the red and ultra-red waves of light, and he threw on the screen photographs of the spectrum from the line C to a wave-length of 10,000, the ultra-red showing remarkable groupings of lines. He further showed that by friction the blue film was changed to the red, and in that state was not sensitive to the lower part of the spectrum. These photographs were taken by means of a diffraction grating, and Captain Abney demonstrated Fraünhofer's method of separating the various orders of spectra produced by it. He then explained that recently he had elucidated the reason of the reversal of Draper's pictures by the least refrangible end of the spectrum. He finds that it is accelerated by exposing the plates in weak oxidising solutions, such as those of hydroxyl, bichromate of potash, permanganate of potash, and nitric acid, or exposure to ozone. The red rays, in other words, seemed to oxidise the photographic image, and to render it incapable of development.

Mr. H. BAUERMAN then exhibited some paper models, illustrative of the disposition of the planes of symmetry in crystals. These included octants of the sphere with enclosed cube and octahedron faces pointed into their corresponding hexakis octahedral faces, a cubic skeleton built up from nine planes of symmetry, with a removable outer shell, and a system of axial planes of an unsymmetrical mineral, enclosing a solid nucleus contained between three parallel pairs of planes. They were constructed for the purpose of showing popularly the difference between planes of symmetry and other diametral planes by laying upon them a small mirror or plate of mica, when, in the first case, the enclosed nucleus gave a symmetrical image corresponding in position to the plane immediately behind the mirror, but in the second a broken image is produced.

Dr. GUTHRIE exhibited the arrangement of apparatus he had employed, in conjunction with his brother, to ascertain the effect of heat on the transpiration of gases. The main difficulty connected with the research was the securing of an absolutely constant pressure on the air operated upon. This was secured by inserting into the neck of the vessel which served as an air-chamber a tube turned up at its inner end and terminating externally by a small funnel; as the tube was kept constantly full of water, the funnel overflowing, a pressure represented by the difference between the heights of these levels was maintained. After passing through a series of drying tubes the air traversed the (U-shaped) capillary tube in a beaker containing water of known temperature, and was finally received in an inverted tube contained in an overflowing dish of water. Among other results it was found that the resistance of a tube is the same as that of its several portions, and if t be the time occupied, T the absolute temperature, P_1, P_2 the pressures, and α and β constants, they find that—

$$t = \alpha T\left(T + \frac{\beta}{P_1 - P_2}\right).$$

NOTICES OF BOOKS.

A Treatise on Photography. By W. de WIVESLIE ABNEY, F.R.S., Captain in the Royal Engineers, &c. Longmans and Co. 1878.

CAPTAIN ABNEY'S work forms one of the admirable series of "Text-Books of Science" now in course of publication by Messrs. Longmans. In this treatise Captain Abney enters more fully into the history and theory of photography than any other purely English author has done since the days of Hardwich. He opens with a short account of the early discoveries of Scheele, Ritter, Wedgwood, Niepce, Daguerre, Talbot, Herschel, Scott Archer, and others. In speaking of Wedgwood's discoveries the author calls attention to a strange misconception with regard to the paper read by Wedgwood at the Royal Institution, entitled "An Account of a Method of Copying Paintings on Glass, &c." The vague wording of this title has led certain writers to claim for Wedgwood the credit of having been the first to take a glass negative; but the real fact of the matter is that Wedgwood did not make photographs on glass, but only copied designs which were drawn or painted on that material. The second chapter gives us a general account of the properties of light in relation to photography, the third chapter being devoted to a very lucid explanation of the theory of the action of light on sensitive compounds. Chapter IV. gives an account of the action of light on the different salts of silver, iron, uranium, and chromium; also on asphaltum, dyes, and a mixture of chlorine and hydrogen. In connection with this subject Captain Abney mentions a curious fact that does not seem to be generally known. Mr. F Jones, of Manchester, has discovered that if we expose sulphur to sunlight in an atmosphere of antimony or arsenic hydride, we get antimony or arsenic sulphide and hydrogen sulphide. This discovery ought to open up a wide field of research into the effects of light on similar substances. We are so accustomed to investigate the properties of compounds which have been formed or broken up under the influence of light that we are totally unacquainted with the reactions which go on or do not go on in darkness. Chapter VI. treats of the Daguerreotype, but seeing that this process has lately been resuscitated for certain astronomical work it might well have been made longer. Has the Daguerreotype ever been used for spectroscopic photography? Surely some process of etching the silver plate and printing from it direct might be devised. A rigid metallic plate would be infinitely more trustworthy for such work than an unequally contractile collodion film. The chapter on "Defects in Negatives" will soothe the troubled spirits of many amateurs and professionals. The various dry-plate and emulsion processes next come in for treatment, the same judicious mixture of practice and theory being still kept up, little experiments being given here and there confirmatory of the author's views. Printing in all its branches, both on paper and glass, and the toning and fixing processes, next receive attention, the various tissue, gelatine, Woodburytype, relief, and autotype processes being fully explained and their special merits discussed. Actinometry, photospectroscopy, celestial photography, and micro-photography end the book. The chapter on "Miscellaneous

Applications of Photography" might have been made longer, a remark that will apply to several other chapters in the book. The scientific chemist who perhaps has never coated a plate in his life will find a number of interesting theoretical considerations dispersed through the book which he may read with both pleasure and profit. The book is illustrated with a large number of excellent woodcuts, and is printed in clear legible type; the index, however, might have been made a little more copious.

Mineralogy. By J. H. COLLINS, F.G.S. Vol. I. The General Principles of Mineralogy. London and Glasgow: W. Collins, Sons, and Co.

THIS volume forms one of Collins's Advanced Series, and is designed to give those students who have not had a mathematical training a good insight into the principles of crystallography, a branch of science which has been strangely neglected of late years. Thn system adopted is that of Prof. Miller, of Cambridge. Clear directions are also given for the measurement of the angles of crystals, a subject which has been surrounded with an unnecessary amount of mystery. The various physical properties of crystals are also described. The article on "Blowpipe Analysis" is unnecessarily meagre, a remark that will apply with equal force to the index. This defect, however, is perhaps more the fault of the publisher than the author. Vol. II., which will shortly be published, will treat of systematic mineralogy. The work is illustrated by nearly six hundred woodcuts and diagrams.

Science for All. Illustrated. Parts I. to IV. London: Cassell, Petter, and Galpin.

Science for All is a new monthly journal of every-day science which is intended to fill up the wide gap at present existing between the numerous periodicals intended for professional scientific men and the many childish and misleading so-called popular scientific articles which we so frequently find occasion to laugh at in the daily and weekly press. The Jablochkoff Electric Candle, the Colorado Beetle, and the Telephone produced a plentiful crop of these. The articles in *Science for All* embrace the whole range of Natural Science, and are written in a style within the ken of any ordinarily well educated reader. An article on Limestone, by Prof. Nicholson, of St. Andrews; an excellent one on "Ice, Water, and Steam," by Mr. J. E. H. Gordon, of Cambridge; another on the "Chemistry of a Brewer's Vat," by Mr. W. B. Ferguson, of Oxford, may be taken as specimens of what good popular scientific writing should be. An article on "Whirlpools and Whirlwinds," by Mr. W. Ackroyd, is also an excellent type of its class. Beginning with the familiar whirlpools which we set up in our teacups when we endeavour to melt a refractory lump of sugar in our tea, Mr. Ackroyd leads his reader past the Malström and Charbydis; introduces him to the Bell Animalcule; shows him an Indian dust-whirlwind at a distance; teaches him how to make smoke rings and liquid vortex rings; and finally lands him in the midst of Professor Thomson's Theory of Vortex Atoms. The articles on Astronomy, by Mr. R. A. Proctor; on Hunger, by Mr. R. Wilson; and on several other subjects, which are beyond our scope, are excellent in their way. The new journal is ably edited by Dr. Robert Brown, F.L.S., formerly Lecturer on Geology and Physical Geography in the School of Arts, Edinburgh, and author of one of the best elementary manuals of botany which we possess. Dr. Brown himself contributes two excellent articles, one on "A Highland Glen," and another on "A Fallen Leaf." The journal is well illustrated with numerous woodcuts and a coloured lithograph showing the succession of rocks which constitute the crust of the earth.

CORRESPONDENCE.

THE APPLICATION OF SONSTADT'S SOLUTION TO THE SEPARATION OF MINERALS FOR CHEMICAL ANALYSIS.

To the Editor of the Chemical News.

SIR,—In my paper on some uses of Sonstadt's solution, in the *Mineralogical Magazine* for November, 1877, I say:—"More than this, two minerals, if of different specific gravities, provided one is less than S.G. 3·0, may often be easily separated from one another, if they are in fragments of appreciable size. . . . A very simple apparatus is required for this purpose. . . . A few repetitions of the process seldom fail in effecting such a separation in an hour as would have taken days, or have been impossible by the ordinary method of mechanical selection." It is scarcely necessary to state that chemists are not in the habit of making laborious separations of mixed crushed minerals except for the purpose of subsequent chemical analysis of the selected fragments. The above quotation, which summarises my three or four years' experience in the use of Sonstadt's solution for the separation of minerals from each other for the purposes of analysis, should suffice to show that I do not look upon the distinguishing of different gems as the most important application of this liquid. Several of my recent contributions to mineralogical chemistry could not have been made without its assistance: several rare specimens of mineral phosphate, wholly entangled in a siliceous gangue, have been isolated in a condition of perfect purity by its means. I have often identified the minerals of a crushed fragment of rock by introducing a drop of the solution into the "live-box" under the microscope. By using solutions of increasing strength, or adding the solid salt, the felspars, the quartz, and then some of the heavier minerals may be successively brought to the surface, and thus into focus. But this and other applications of the solution naturally flow from Sonstadt's original suggestion.—I am, &c.,

A. H. CHURCH.

P.S.—I see in a recent number of the *Comptes Rendus* that a M. Thouret has just made the discovery that a solution of mercuric iodide in a solution of potassium iodide may be employed for the purposes to which Mr. Sonstadt and myself have so long put it.—A. H. C.

WEIGHING PRECIPITATES.

To the Editor of the Chemical News.

SIR,—The CHEMICAL NEWS is always very welcome out here, and I trust you will kindly excuse this little effusion from the Arctic backwoods on account of the interest taken by the writer, through the CHEMICAL NEWS, in chemical matters. Permit, therefore, dear Sir, my reference to Mr. Clark's article, "On a New Method of weighing Precipitates" (vol. xxxvii., p. 109). The method is not new, as I have read a full description of it in a number of the *Journal für Praktische Chemie* in 1861 or 1862. I then have tried it repeatedly, but had to abandon it because in—

$$\frac{Ca}{a-1}$$

a is found by weighing, and being always in the divisor, the slightest mistakes are magnified thereby to such an extent as to render it unreliable. I remember to have tried to eliminate a, or to change the equation, but did not succeed. Could this be done a very great advantage would doubtless result.—I am, &c.,

Dr. VOLNEY.

The Volney Powder Works, Brockville,
March 30, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft, No. 1, 1878i

Transformation of Nitriles into Amides.—A. Penin and Fr. Klein.—The authors describe a compound which was briefly mentioned in a former communication and which is a polymerised benzonitrile, C_7H_5N, and in all its properties identical with the kyaphenin obtained by Cloëz by the action of potassium cyanate and chlor-benzoyl. They have obtained benzimido-amide, $C_7H_8N_2$, by the action of cold soda-lye upon its hydrochlorate, and have examined its behaviour with various reagents.

Relations between the Atomic Weights of the Elements.—Fr. Waechter. (Table I.).—The Table I. expresses the mutual relations of the various groups. The horizontal lines contain analogous elements of similar valence, whose equivalents increase approximately by a multiple of 16 units. In the vertical columns the elements rank according to their decreasing atomic weights, the valence in each case rising and falling in the series I., II., III., IV., III., II., I.

	a.	*a*+(1·16).	*a*+(2·16).	*a*+(3·16).	*a*+(4·16).	*a*+(5·16).	*a*+(6·16).	*a*+(7·16).	*a*+(8·16).
Univalent ..	Fl = 18·960	Cl = 35·457	—	—	Br = 79·952	—	—	I = 126·85	—
Bivalent ..	O = 16·000	S = 31·978	—	—	Se = 79·480	—	—	Te = 128·000	—
Trivalent ..	N = 14·044	P = 31·045	—	—	As = 74·915	—	—	Sb = 122·265	—
Quadrivalent	C = 11·970	Si = 28·050	—	—	76	—	—	—	—
Trivalent ..	Bo = 10·800	Al = 27·480	Y = 46·200	—		—	—	—	Di = 138·100
Bivalent ..	Be = 9 300	Mg = 24·380	Ca = 39·974	—		—	—	—	Ba = 137·166
Univalent ..	Li = 7·022	Na = 23·043	K = 39·137	—		—	—	—	Cs = 133·036

This arrangement brings to light the following points:—(1). The affinity of the elements decreases from fluorine to silicon with the increasing atomic weight and valence; from silicon to cæsium it increases with the still rising atomic weight, but with the falling valence. The two end members, fluorine and cæsium, have the strongest but opposite affinities; the remaining elements have feebler affinities the nearer they approach the middle of the series. If the strength of the affinity of an element in comparison with the affinity of another element is decided according to the manner in which decompositions take place (if, *e.g.*, potassium decomposes sodium chloride or sodium potassium chloride) the above proposition comprehends 6706 cases of decomposition. By means of experiments already made, however, and from analogy it can only be maintained that 658 cases of decomposition occur in accordance with the above law, while 26 cases are contradictory. No data exist for the decision of the remaining 5922 theoretically possible cases of decomposition. (2.) The arithmetical mean of the atomic weights of two elements of equally intense but opposite affinity is approximately 76. If the amount of heat appearing on a chemical combination is regarded as the measure of chemical affinity, according to proposition 2, the same amount of heat must be liberated when equal quantities of iodine and magnesium, or of tellurium and sodium, enter into combination. (3.) The melting-points and boiling-points of the elements named in the table increase from fluorine to silicon with the increasing atomic weight and valence; from silicon to cæsium they decrease with increasing atomic weight and still falling valence. Of 22 melting-points 20 agree with this proposition, while 2, phosphorus and silicon, disagree. Out of 10 boiling-points 9 agree. (4.) The specific heats of the elements contained in the table, as far as known, decrease with the increasing atomic weight and valence. (5.) The specific gravity of the elements in the table in the solid state is in corresponding tomic weights (those in the same perpendicular series), the greater, the higher is the valence. (6.) The affinity of the negative non-metallic elements—fluor and silicon—for the true metals decreases with the increasing atomic weight and valence.

Xylol-sulphonic Acids and Xylenols.—Oscar Jacobsen.—A lengthy memoir, not adapted for useful abstraction.

Pseudocumenol and Constitution of Pseudocumol-sulphonic Acid, Durol, &c.—Aug. Reuter.—Pseudocumenol, $C_9H_{11}OH$, is easily volatilised along with watery vapour, and congeals chiefly in the refrigerator to a white crystalline mass with an odour of phenol. It melts at 69°, and boils at 240°. It is almost insoluble in cold water but very readily soluble in alcohol and ether. The solutions are not coloured by ferric chloride.

Certain Derivatives of Pseudocumol-sulphonic Acid.—J. Radlofi.—The author has prepared pseudocumol-sulphochloride; pseudocumol-sulphinic acid, with certain of its salts; pseudocumol-sulphydrate, and pseudocumol-disulphide.

Vapour-Tensions of Certain Chemical Compounds and their Determination.—Alex. Naumann.—The author gives the vapour tensions of toluol, nitrobenzol, ethylbenzoat, naphthalin, and anthraquinon.

Reduction of the Nitro Compounds with Stannous Chloride, and Quantitative Determination of the Nitro Group.—H. Limpricht.—The reduction of nitro compounds is better effected with an acid solution of stannous chloride, in place of granulated tin and hydrochloric acid. The nitro compound to be reduced is added to the clear acid solution of stannous chloride containing about 150 grms. tin per litre. The reaction as a rule takes place without the aid of heat, and if the quantities are large the liquid may run over. The author was led to apply this reaction to the quantitative determination of the group NO_2 in organic compounds. If a weighed quantity of an organic nitro compound is heated with a known volume of solution of stannous chloride of known strength the transformation of NO_2 in NH_2 takes place according to the equation:—

$$NO_2+3SnCl_2+6HCl=NH_2+3SnCl_4+2H_2O.$$

The quantity of NO_2 in the nitro compound can then be found from the excess of unconsumed stannous chloride, the amount of which is readily and accurately determined by titration.

Quantitative Determination of NO_2 in Nitro Compounds.—H. Limpricht.—The author returning to the subject treated in the last paper describes certain additional precautions required for volatile substances.

Schizomycetenic Fermentations, No. III.—A. Fitz.—A thorough examination of the fermentation induced in various organic bodies by the Schizomycetes or split fungi. The author considers that in the fermentation o starch induced by *Bacillus subtilis* butyric acid is produced directly without the appearance of lactic acid as an intermediate product.

On Betulin.—A. P. M. Franchimont.—The author announces that H. Wigman has been engaged in his laboratory with the examination of betulin, and has arrived independently at results similar to those just published by MM. Paterno and Spica.

On Para-iodo-benzyl Compounds.—C. F. Mabery and C. Laing Jackson.—An account of para-iodo-benzyl-

bromide, para-iodo-benzylic-alcohol, para-iodo-benzyl-cyanide, para-iodo-alphatoluylic acid and its salts.

Action of Sodium on Ethoxacetic-ester. — Max Conrad.—The author has repeated the experiments of Geuther on this subject.

Method for the Separation of Crystalline Silicic Acid, especially Quartz, when mixed with Silicates. — E. Laufer. — The author takes advantage of the property of phosphoric salt to dissolve metallic oxides at a melting heat, and to isolate silicic acid from silicates without attacking quartz. To the finely powdered material weighed in a platinum capsule, phosphatic salt was added in a larger quantity than was required for the solution of the silicates supposed to be present, the crucible not being more than half full. It was gradually and cautiously heated in the air-bath, then melted, the heat being finally urged with the blast till the mixture was in tranquil fusion. The cold mass was easily separated from the crucible, and was then boiled for a length of time with dilute hydrochloric acid, washed by decantation, and filtered, the silicic acid being then extracted from the residue with boiling soda.

Action of Sodium upon Monochloro-ethylen-chloride.—H. Brunner and R. Brandenburg.—The resulting substances are acetylen, ethylen, dichlor-ethylen, and hydrogen.

Reply to the Renewed Attacks of H. Moritz Traube.—F. Hoppe-Seyler. — A controversy regarding priority, H. Traube maintaining that he has essentially anticipated H. Hoppe-Seyler's theory of fermentation.

On Pinakones and Pinakolines.—W. Thörner and Th. Zincke.—The authors here describe the benz-pinakolines and the tolylphenyl-pinakolines.

On the Substances formed from Hydro- and Isohydro-benzoin by the Action of Dilute Sulphuric Acid.—A. Breuer and Th. Zincke.—In a previous communication the authors have considered the two substances in question as simple aldehyds of the two alcohols—physically distinct, though chemically identical —hydro- and isohydro-benzoin, and they find this view confirmed by their subsequent researches.

Action of Iodine upon Phenylated White Precipitate. — Ch. Rudolph. — The substances formed are di-iod-aniline and mono-iod-aniline.

Anthraquinon Carbonic Acid, Oxyanthraquinon Carbonic Acid, and Alizarin Carbonic Acid.—W. Hammer schlag.—The first-mentioned acid is obtained by dissolving methylanthraquinon in glacial acetic acid, and keeping it at a boil for six hours with an excess of chromic acid. The product, when cold, is diluted with water, filtered, washed, boiled with a slight excess of caustic soda, and filtered whilst hot. On adding hydrochloric acid to the filtrate, anthraquinon carbonic acid is deposited as a very voluminous curdy precipitate. It is soluble in glacial acetic acid, and crystallises in long thin needles, scarcely to be distinguished from anthraquinon, and melting at 280°. Its composition is—

$$C_{15},H_8,O_4.$$

Oxyanthraquinon Carbonic Acid.—If the sodium salt of the former acid is fused with 6 parts of caustic soda, and maintained for about 6 hours at 200°, a coloured melt is obtained, which might be mistaken for alizarin, but which is the sodium salt of the new acid. If it is dissolved in water, and precipitated, while boiling, with hydrochloric acid, a deposit of orange-yellow flocks is obtained, closely resembling alizarin. It is, however, distinguished from all the oxyanthraquinons by its perfect solubility with a brown-red colour in sodium acetate, or ammonium oxalate, in which the oxyanthraquinons are insoluble. Its composition is $C_{14}H_6(OH)(COOH)O_2$. Alizarin carbonic acid, or as the author considers it, dioxy-anthraquinon carbonic acid, consists of $C_{15}H_8O_6$. The author gives a comparative table of the respective reactions of monoxy-authraquinon carbonic acid, and o dioxy anthraquinon carbonic acid, and adds a speculative appendix on the constitution of anthraquinon carbonic acid, of mono- and dioxy-anthraquinon carbonic acids of purpurin, and purpuroxanthin carbonic acids of methyl-anthraquinon, and methyl-anthracen.

On Certain Double Salts of Thallous Cyanide, and on a new Thallous Thallic Cyanide.—C. Froumüller. —The double salts examined and described by the author are the thallio-cyanides of silver, zinc, mercury, and cobalt. The thallous-thallic cyanide, $Tl_2C_4N_4$, is formed by treating thallium oxide with a solution of hydrocyanic acid (containing about 20 per cent of dry acid) in the cold. The author has also obtained thallium sulphocyanide, by treating the last-mentioned compound with sulphuretted hydrogen.

On Benz-erythren.—G. Schultz.—The author obtained benzerythren among the products formed by passing benzol through an ignited tube. It is insoluble in water, almost insoluble in alcohol, scarcely soluble in boiling glacial acetic acid, and in cold benzol, though it is readily taken up by the latter solvent with the aid of heat, and crystallises on cooling in small shining leaflets, which melt at 307-308°. It is not identical with Rasenack's parachrysen.

The Meteor of Sokol Banja in Servia.—S. M. Losanitch.—The meteor in question fell on Oct. 1/13, 1877, about 2 p.m. It consists of—Metallic iron 3·8, silicate 96·2, and in addition some iron pyrites. The pure fragments of iron contain—

Fe	78·13
Ni	21·70
Cu	0·17
	100·00

The iron pyrites is a monosulphide, containing no copper and mere traces of nickel. In the silicated mass a small amount of chrome-iron was detected.

Sulphates of Vanadium Pentoxide.—B. W. Gerland.—The compounds examined are—

$$V_2O_53SO_3V_2O_52SO_3,V_2O_23SO_4$$

vanadylid sulphate, which forms double salts with potash and ammonia, but not with soda or magnesia.

Action of Chloride of Iodine upon the Aromatic Amines.—A. Michael and L. M. Norton.—The authors have examined the action of chloride of iodine upon acetanilid; of two mols. chloride of iodine upon 1 mol. acetate of aniline; of 3 mols. chloride of iodine upon 1 mol. anilin hydrochlorate; of chloride of iodine upon metanitraniline, para-nitratiline, and paratoluidin hydrochlorate.

Aromatic Sulphones.—A Michael and A. Adair.—(Second part.) An examination of phenyl-tolyl-sulphon, $C_{13}H_{12}SO_2$; para-sulpho-benzid carbonic acid,—$C_{13}H_{10}SO_4$ and sulpho-benzid-dicarbonic acid, $C_{14}H_{10}O_6S$.

On Derivatives of Methylated Protocatechuic Acids.—Kaeta Ukimori Matsmoto.

On a Dimethyl-oxylated Benzoyl Carbonic Acid belonging to the Protocatechuic Acid Series, and its Relation to Alpha-homo-veratric Acid (Dimethyl-alpha-homo-prote-catecouic Acid.)—F. Tiemann and Kaeta Ukimori Matsmoto.—These two papers are not adapted for abstraction.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.

No. 51, March, 1878.

Report Presented by M. Bérard on Behalf of the Committee of Chemical Arts on M. Houdart's New Process for the Determination of the Dry Extract of Wines.—This process applies merely to the ordinary qualities of wine in daily consumption. M. Houdart, after having distilled off the alcohol, dilutes the residue with water sufficient to reproduce the original volume, and

takes its specific gravity with the hydrometer. The results thus obtained appear to bear a definite relation to the quantity of fixed solids present in the wine.

Detection of Fatty Bodies Fraudulently Introduced into Butter.—C. Husson.—The author's process is too lengthy for a full description. He places in each of a number of test-tubes 10 grms. of the whitest castor oil, and adds to one 1 grm. of the sample to be examined, and to the others 1 grm. each of the various fatty matters with which the butter is likely to be sophisticated. The tubes are then plunged in the water-bath and the appearances presented at different temperature are noted. The mixtures are then treated with cold alcohol at 90 per cent, the emulsions formed are filtered, the residue washed with more alcohol, and dried in a current of air. One grm. of tallow thus leaves a deposit of 1·20 grm., whilst pure butter yields only 0·70. The author also dissolves fats in equal weights of glycerine, heating, agitating, and treating the emulsion formed with an equal weight of alcohol at 90 per cent, and of ether at 66 per cent. The tubes containing these mixtures are placed in the water-bath, maintained at 25°, and the strata of liquid produced are examined. With pure butter the lower stratum is slightly opalescent, the more decidedly the more milk is shut up in its texture. With margarine, lard, tallow, &c., this phenomenon is, of course, wanting. The tubes are afterwards withdrawn from the water-bath, let cool to 18° or 20°, and the deposits produced are examined with the microscope.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 10, March 7, 1878.

A Little about Telephony.—J. Luvini.—This paper cannot be reproduced without the accompanying diagrams.

Part Played by Ferments in the Nutrition of Plants.—M. Morren.—The author shows that digestion depending upon the action of ferments is not exclusively peculiar to carnivorous plants, but is common to all vegetables.

Reimann's Färber Zeitung,
No. 11, 1878.

Dr. Reimann finds that the milk of sulphur is utterly useless as a mordant for eosin, its supposed beneficial action being due to a small excess of hydrochloric acid added along with the hyposulphite of soda.

MISCELLANEOUS.

Dublin University Experimental Science Association.—The second general meeting of the session was held in the Museum Buildings (New Square), Trinity College, on Wednesday, April 10, 1878, Prof. Emerson Reynolds, M.D., in the Chair. The following communications were made:—Denis M'C. Mahony, B.A., "On the Triatomicity of the Halogens;" E. P. Culverwell, B.A., "On the Appearance presented by Rainbows on Different Planets;" J. D. Pratt, B.A., "On the Estimation of Free Carbonic Acid in Water with the aid of Phenol-phthalein;" Messrs. Coffey and Falkiner, "On the Action of Sodic Hypobromite on Ammonic Sulphocyanate and on the Sulph-urea." The meeting then adjourned.

South London School of Pharmacy.—On Monday, April 15 (being the first day of the third term of the session), the Secretary, Mr. Baxter, presented the medals and certificates to the following successful competitors:—Medal, Senior Chemistry, Mr. Hutton; Medal, Junior Chemistry, Mr. Davies; Medal, Materia Medica, Mr. Parker; Medal, Botany, Mr. Stonham; Medal, Pharmacy, Mr. Richards; Certificate, Senior Chemistry, Mr. Barrow; Certificate, Junior Chemistry and Materia Medica, Mr. Richards; Certificate, Botany, Mr. Nicholson; Certificate, Pharmacy, Mr. Pocock.

NOTES AND QUERIES.

Ansell's Fire-Damp Indicator.—In volumes xii. and xv. of the CHEMICAL NEWS there is described an apparatus for the detection of fire-damp in mines by means of diffusion. Can any of the readers of the CHEMICAL NEWS inform the writer if this apparatus has ever been in practical use, and, if so, where? If it has not been, what have been the objections to it, and, otherwise, has it failed to answer the purpose? The late numerous explosions in mines make it desirable that some means to detect a sudden outburst of fire-damp should be found, and Ansell's apparatus seems, if there be no practical objections to its use, to answer the purpose.—H. C. S.

TO CORRESPONDENTS.

M. H. Coehrane.—The Chemical Society could not interfere in the matter you refer to.

F. Campin.—No such process is known.

T. H. Davis.—Apply to Messrs. Hachette or to Messrs. Baillière.

G. H. Sharpe.—You had better advertise. We do not know of any such appointment vacant.

MEETINGS FOR THE WEEK.

TUESDAY 23rd.—Civil Engineers, 8.
THURSDAY, 25th.—London Institution, 12. (Anniversary.)
FRIDAY 26th.—Quekett. 8.
SATURDAY, 27th.—Physical, 3.

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LECTURE HOUR, THREE O'CLOCK.

W. T. THISELTON DYER, M.A., B.Sc., F.L.S., Assistant Director, Royal Gardens, Kew.—Five Lectures on Some Points in Vegetable Morphology; on Tuesday, April 30 to May 28.

LORD RAYLEIGH, M.A., F.R.S.—Four Lectures on Colour; on Thursdays, May 2 to 23.

Professor HENRY MORLEY.—Four Lectures on Richard Steele; on Saturdays, May 4, 11, 18, 25.

Rev. W. H. DALLINGER, F.R.M.S,—Three Lectures on Researches in Minute and Low Forms of Life; on Tuesdays, June 4, 11, 18.

Professor F. GUTHRIE, F.R.S.—Three Lectures on Studies in Molecular Physics; on Thursdays, May 30, June 6, and June 13.

JAMES SULLY, Esq.—Three Lectures on the Psychology of Art; on Saturdays, June 1, 8, 15.

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The Friday Evening Meetings will be resumed on May 3rd, at 8 p.m. when Mr. Spottiswoode, Sec. R.I., will give a Discourse on "Polarised Light: a Nocturne in Black and Yellow," at 9 p.m. Succeeding Discourses will probably be given by Sir Wm. Thomson, Mr. A. Graham Bell, Professors Ramsay and Flower, Mr. Walter H. Pollock, and Professor Dewar.

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THE CHEMICAL NEWS.

Vol. XXXVII. No. 961.

ON SOME CANDLES ALTERED BY LONG EXPOSURE TO SEA-WATER.

By J. H. GLADSTONE, Ph.D., F.R.S., Pres. C.S.

I am indebted to Mr. Latimer Clark for some specimens of candles which are stated to have been recovered from the wreck of a Dutch vessel, sunk in Vigo Bay during the war in the year 1702. As the vessel was supposed to be a treasure ship many attempts have been made to recover its contents, and this was successfully accomplished in 1875, when these candles, among other things, were obtained. They have therefore been submerged for 173 years.

The wick has rotted away, leaving scarcely any trace of its existence, while the fatty portion has become a friable heavy substance, of a dull white colour. The candles bore evidence of having been made by dipping, for the concentric layers were easily separated from one another, and this facilitated the examination of the outer and inner portions of the same piece.

Both the outer and inner portions still contain some of the fat apparently unchanged; they are unctuous to the touch, and have a fatty odour, and when heated to a little below 110° C. they began to change colour; at 140° they softened, and at 200° small portions were melted out. This easily fusible matter dissolved readily in ether, and was almost white. Indeed the fat can be easily separated from the rest by treating the altered candles with ether and benzene, and in one experiment, made on 2 grms. of the candle, 0·879 grm. of fat, or 44 per cent of the whole, was thus dissolved out.

Pieces exposed to the heat of a lamp flame gave off combustible vapours, as might be expected, with the usual smell of burnt fat.

After complete combustion there remained a strongly alkaline white ash, consisting of carbonate and chloride of calcium and sodium, with traces of magnesium and potassium. The outer layers of one of the pieces, weighing 2·035 grms., yielded 0·147 of ash, or 7·2 per cent. The inner layers, weighing 2·262 grms., yielded 0·1907 grm., or 8·4 per cent. The chlorine in the first portion was estimated at 0·0266, and in the second at 0·0233: if this existed wholly as chloride of sodium it would indicate 2·15 and 1·70 per cent respectively; but as sea-water usually contains about 2·8 per cent of this salt, and the porous candles were no doubt saturated with sea-water, and allowed to dry in that condition, the chloride of sodium may be regarded as extraneous. The amount of calcium in the outer layers was found to be 0·053, and in the inner 0·0821: if this existed wholly as stearate of calcium ($C_{36}H_{70}CaO_4$) these figures would indicate 39·5 and 55 per cent respectively, but there seems also to have been present a certain amount of stearate of sodium. The excess of sodium in the inner portion beyond what was necessary to saturate the chlorine amounted to about 0·0098, indicating at least 5·76 per cent of stearate.

It thus appears that the fat has been converted in great measure into calcium and sodium salts, doubtless by the slow replacement of the triatomic group C_3H_5 in the stearine by 3 atoms of the metal, with the simultaneous production of glycerin.

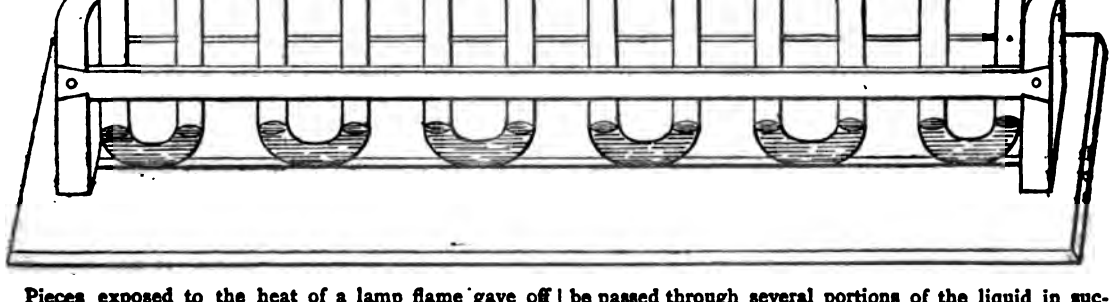
Though the calcium in sea-water is far less abundant than the sodium, it appears to have had a much greater effect; but it is, of course, impossible to say whether the one salt has not been made by double decomposition from the other.

The most interesting point, as it appears to me, is that whereas the fats have been in contact with a practically unlimited amount of sea-water for 173 years, and a chemical change between them has been possible, the double decomposition has proceeded so extremely slowly that the reaction is only about half completed at the present time.

A GAS-ABSORBER.

By G. GORE, LL.D, F.R.S.

Every chemist is well aware that by the single passage of a bubble or stream of gas through a liquid, the former touches only to a small extent the latter, and requires to be passed through several portions of the liquid in succession before it is completely absorbed or purified.



When either Woolf's bottles or bent glass tubes are employed for the purpose, in the former case a considerable bulk of liquid must be used, and in both cases a number of junctions must be made with the different parts of the apparatus, and a proportionate risk of leakage incurred. I have therefore constructed the apparatus shown by the annexed sketch, for the purpose of quickly saturating a small bulk of liquid with a gas, or speedily

absorbing a small quantity of gas by a liquid, without requiring many junctions to be made. It consists of a single glass tube, of about half an inch external diameter, bent into a series of four or six double curves, the upper part of each of which is provided with a neck (closed by an india-rubber bung), so that each limb of the tube may be readily cleaned. The tube is supported and kept steady in the manner shown in the sketch.

Having used the apparatus, and found it very effective and convenient for the intended purpose, and having been unable to find such an arrangement described in any catalogue of chemical apparatus, I have ventured to publish this description.

PROCEEDINGS OF SOCIETIES.

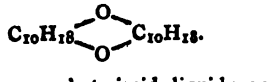
CHEMICAL SOCIETY.

Thursday, April 18, 1878.

W. CROOKES, F.R.S., Vice-President, in the Chair.

AFTER the announcement of visitors, confirmation of minutes, &c., the following certificates were read for the first time:—H. R. Smith and J. H. Wilson.

The CHAIRMAN then called on W. A. TILDEN, D.Sc., to read a paper on "*Terpin and Terpinol.*" Terpinol is the name given by List to the liquid obtained by the action of dilute acids upon terpin hydrate: conflicting statements as to its composition and properties have been given by Wiggers, List, and Oppenheim. The author's experiments lead him to conclusions which differ materially from those made by the above chemists, and the author has brought this preliminary account before the Society although the subject is by no means complete. *Crystallised Terpin*, $C_{10}H_{20}O_2.OH_2$.—This compound was prepared by the process suggested by Wiggers. A mixture of 1 volume of nitric acid, 1 volume of methylated spirit, and 2½ volumes of rectified turpentine oil, is allowed to stand about two days: it is then poured into a dish, after the addition of a small quantity of methylated spirit. Terpin is deposited in successive crops of crystals. No crystalline compound is obtained from the terpenes of the orange group; but the same compound is obtained whether American or French turpentine oil be used. *Action of Dilute Hydrochloric Acid on Terpin.*—To 53·5 grms. terpin, boiled up with 700 to 800 c.c. water, 12 drops of hydrochloric acid are added, and the liquid distilled. An oily product, terpinol, distilled over between 205° and 215° unchanged; it has the formula $C_{10}H_{18}O$, and probable composition—



It is a colourless, somewhat viscid liquid; sp. gr. at 16°, 0·9274. It has no action on polarised light. When dry hydrochloric acid gas is passed into it, its colour becomes purple, and ultimately a mass of crystals is formed, which by pressure can be obtained perfectly white. This new body has the composition—

$$C_{10}H_{18}\begin{cases}Cl\\Cl\end{cases}$$

and is therefore the dihydrochloride. If an alcoholic solution of terpinol be acidified with nitric acid, and the mixture placed in a dish, crystals of terpin are deposited. From this and other considerations the author concludes that, in the preparation of terpin by the ordinary process, terpinol is formed at a certain stage of the reaction. By the action of dilute sulphuric acid, 1 in 8, on terpin, and subsequent distillation in a current of steam, an oily product was obtained, which analysis indicated as a mixture of a hydrocarbon, $C_{10}H_{16}$, with terpinol. The crude product was therefore boiled for two to three hours with dilute sulphuric acid, 1 in 2, and distilled, finally from sodium: a liquid was thus obtained boiling at 176° to 178°, vapour density 68·8, with the formula $C_{10}H_{16}$, sp. gr. at 15°, 0·8526. It is optically inactive, gives no crystalline deposit with hydrochloric acid, and no crystalline nitroso-compound. A dibromide was prepared. The author suggests the name "terpinylene" for this hydrocarbon, which resembles in many respects the hydrocarbon characteristic of Russian turpentine oil. The author has made a preliminary examination of the oxidation products of terpinol and terpinylene.

After some remarks by Dr. ARMSTRONG the thanks of the Society were given to Dr. Tilden for his valuable paper.

Dr. ARMSTRONG then read a paper entitled "*The Poisonous Principle of Urechites suberecta*," by J. J. BOWREY. The *Urechites suberecta* is a common wild plant in Jamaica, where it is called Nightshade, from its well-known deadly properties. Its dark green leaves and large bright yellow flowers render it a conspicuous object. It is believed to have been frequently used as a poison by the negroes in former times, and occasionally its employment has been suspected at the present time. It is stated that by suitable doses it can be administered so as to produce death, either immediately or after the lapse of some weeks. Experiments by the author prove that this statement has some foundation. Three active substances have been obtained in a pure form—urechitin, urechitoxin, and amorphous urechitoxin. They are extracted from the leaves, which are physiologically more active than the other parts of the plant. The fresh leaves contain rather more than a half per cent of the active principle. Urechitin is prepared from the air-dried leaves by extracting with alcohol. By using this solvent in various states of dilution the pure substance was obtained in long four-sided prisms, transparent and colourless, containing 6 per cent of water of crystallisation, readily expelled at 100° C. Urechitin is practically insoluble in water and dilute alcohol; more soluble in ether, benzol, amylic alcohol, and strong spirit; and very soluble in hot alcohol, chloroform, and glacial acetic acid. Strong mineral acids decompose it. The reaction with hydrochloric acid proves the substance to be a glucoside. With strong sulphuric acid it gives a characteristic colour reaction. If 0·01 m.grm. be treated with a drop or two of strong sulphuric acid, a yellow solution is formed, which becomes successively orange, red, mauve, and finally purple. These changes of colour are much hastened by heat or the addition of a trace of some oxidising substances (nitrates, nitrites, chlorates, bleaching-powder, bromine, and iodine). The author prefers a trace of a solution made by adding one drop of nitric acid to 100 c.c. of sulphuric acid. The results of several analyses of different samples indicated the formula $C_{28}H_{42}O_8$. It is intensely poisonous and bitter, a solution of 1 in 40,000 having a distinctly bitter taste. Its solutions are also very acrid. Urechitoxin is prepared by a process somewhat similar to that used for obtaining urechitin, but the leaves are first dried completely at 100° C. Basic lead acetate is also used to precipitate the substance in question. It differs from urechitin in being much more prone to undergo change and become amorphous; it is more soluble in water, spirit, amylic alcohol, and chloroform, but less soluble in ether and benzol. It also crystallises less readily. With sulphuric acid it gives a colour reaction almost the same as that yielded by urechitin, and with hydrochloric acid splits up into an inert substance, urechitoxetin, and a body which readily reduces alkaline cupric solutions. Like urechitin, it is bitter, acrid, and exceedingly poisonous; 1-100th grain injected subcutaneously being sufficient to kill a cat within sixteen hours. From several concordant analyses the author deduces the formula $C_{13}H_{20}O_5$. Amorphous urechitoxin was procured as a residue in preparing urechitoxin, but has not been obtained in a pure state. In its toxic and general chemi-

cal properties it closely resembles the crystalline substance. Other substances have been obtained by the author, but to avoid confusion he has not named them, as their composition was not absolutely certain. In conclusion, he states that the poisonous properties of *Urechites suberecta* are mainly due to urechitin, which he obtained by the use of water, alcohol, and a temperature never exceeding 38° C., and that urechitoxin is a product of chemical change from urechitin. The author gives full details of the preparation, solubilities, chemical properties, &c., of the above substances. Specimens of the three bodies were exhibited, and the colour reaction shown at the meeting.

After the thanks of the Society had been given to the author for his interesting communication,

A paper by A. WYNTER BLYTH, entitled "*The Temperature at which some of the Alkaloids, &c., sublime, as determined by an Improved Method*," was read by Dr. ARMSTRONG. Helwig was the first who systematically employed sublimation as a means of recognising the alkaloids, &c. Afterwards, Dr. Guy greatly improved the process. Very wide statements are, however, still made as to subliming-points—*e.g.*, theine, which really sublimes below 100° C., is said by Strauch to sublime at 177°, and by Mulder at 184·7° C. The author investigated the subject, and found these discrepancies to arise—(1) From defects in the apparatus used; (2) the want of a definition of the term "subiimate;" (3) the want of uniformity in general procedure. The method recommended by the author is as follows:—A porcelain crucible about 3 inches in diameter is nearly filled with mercury for low, or fusible metal for high temperatures. A very small quantity of the substance is then placed on a thin microscopical cover-glass, and floated on the fluid metal. The substance is then surrounded by a glass ring (cut from a tube) $\frac{1}{8}$ to $\frac{1}{4}$ in. thick, and covered by a second thin cover-glass. The crucible is supported by a brass plate fixed to a retort-stand, and covered by a flask from which the bottom has been removed. In the neck of the flask is a cork; through it a thermometer passes, which has its bulb immersed in the liquid bath of metal. A first rough determination is made, in which the bath is heated rapidly, and the upper cover-glass changed at every ten degrees. In a second experiment the disk is changed every four to five degrees. In the final determination the disk is renewed every half degree, the temperature being raised with great caution. The author defines a sublimate as the most minute films, dots, or crystals which can be observed by a quarter-inch objective, and which are obtained by keeping the subliming cell at a definite temperature for sixty seconds. The author has used the same apparatus without the upper cover-glass for determining melting-points accurately, the specimen being observed microscopically in order to determine when the first melted drops are formed. The active principles of plants can be classed (in regard to their behaviour to heat) for practical purposes into—(1) Those which give a decided crystalline sublimate; (*a*) below 100° C., *e.g.*, theine, thebeine, cantharidine; (*b*) between 100° and 150°; (*c*) 150° to 200°, pilocarpine, strychnine, morphine, &c. (2) Those which melt, but give no crystalline sublimate—(*a*) below 100°, hyoscyamine, atropine, &c.; (*b*) 100° to 150°, papaverine, &c.; (*c*) 150° to 200°, salicine, &c.; (*d*) above 200°, solanine, &c. (3) Those which neither melt nor give a crystalline sublimate, saponine, &c. In addition to the above substances the author has examined narcein, narcotin, delphinin, theobromine, picrotoxin, and quinidine, and gives details as to their behaviour when heated.

The CHAIRMAN suggested that more accurate results might be obtained by subliming *in vacuo*. He had found that oxalic acid sublimed without decomposition below 100° *in vacuo*.

The thanks of the meeting were given to Mr. Blyth, and the Society adjourned to May 2, when a lecture "On the Chemical Aspect of Vegetable Physiology," will be delivered by Sidney H. Vines.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

Inaugural Address,

By JOHN AFFLECK, M.A., D.Sc., President.

IT is usually expected that the President for the year should append to his opening remarks a paper on some subject of original research. Not having anything of this nature to present to you, I shall content myself with offering a few observations on some of the more salient points in the alkali manufacture, and on some of the improvements that have been made or attempted in it within recent years; premising that, while I am conscious that many of my remarks may contain nothing novel or attractive to many of you, they are offered simply with the hope that they may not fail altogether in proving useful or suggestive to a few.

SULPHURIC ACID.

In the sulphuric acid department there is no radical change, or even important improvement, either in plant or method of working, to be recorded within the last few years. And yet, undoubtedly, much progress is being made from year to year by improving the construction of the plant in a variety of details, by better burning of the pyrites, and by a better comprehension of how the course of the gases through the chambers ought to be regulated and controlled, so as to obtain the best results. In this way the results of chamber working have of late years been so much improved that it is not too much to say that, with a substantially built and ordinarily well-conducted plant, acid making is now the least troublesome and steadiest going department of an alkali works, while the loss of sulphur is being more and more reduced to a minimum.

Passing over the subject of the burning of pyrites, I shall limit the observations I have to make in this department to—

1. Glover towers;
2. Construction, capacity, and working of chambers, and the recovery and losses of nitre; and,
3. Calculation of acid productions.

1. *Glover Towers.*—Since the introduction of the Gay-Lussac tower in France in 1842, no improvement in the acid plant has proved so complete a success as these towers. First erected by Mr. Glover, on the Tyne, some ten or twelve years ago, to serve the double purpose of concentrating the chamber acid and denitrating the nitrous vitriol by utilising the waste heat of the kiln gases, they have now, at least in this country, supplanted all the previous costly and cumbersome methods of concentrating with fuel in pans, and denitrating in steam columns. And, at the present day, these towers are so universally employed that it would be hard to find a single acid plant without them.

The first towers put up on the Tyne were found to be too slimly constructed. So that, during the last few years, all prudent acid makers have been going in for more solid structures, both as regards foundations, timber-framing, and lead work. Side sheets are now very generally put in of 30 lbs. lead as far as the top of the burner pipe, bottoms and upstands 50 lbs. to 60 lbs. lead. Nor can I regard this as in any way a wasteful expenditure of material. On the contrary, it is clearly the wisest economy, if we consider the stoppage of work and the expense of emptying and repacking a tower, when its bottom gives way unexpectedly before the rest of it is much the worse. There is only one other point on this head to which I would direct your attention, and I regard it as of some importance. The temperature of the gases leaving the Glover towers to go to the chambers usually ranges, in my experience, from 140° to 170° F. Now this observation has led me to the conclusion that, as usually built, viz., from 25 feet to 30 feet high, and all the available space

filled with packing of flints or coke, the gases are too much cooled to obtain the greatest possible concentrating power. I consider in fact that, in such cases, the upper part of the tower *undoes*, to some extent, what has been done in the lower and hotter part. The steam evaporated from the acid in the lower and middle sections of the tower, and carried along by the hot gases in their passage upwards, is partly condensed again, when they have been cooled down below the boiling-point by the colder stream of acid they encounter near the top. And thus less concentration is effected than would be if the gases were allowed to escape from the tower at a temperature more approaching the boiling-point, or say 200° F. And this result would be equally produced by a too high, or too closely packed tower, the cooling effect on the gases being the same. Hence it follows that a tower might be made so high as to have practically no concentrating power at all, the gases being cooled at the outlet to near the temperature of the air, and the cold acid poured on at the top running away at the bottom *hot*, but not increased in strength. This view has been confirmed by the improved concentration, along with freer draught, obtained by working with short towers of about 18 feet in height, and by diminishing the packed space in higher ones, in various works in the neighbourhood.

2. *Chamber Construction, Capacity, &c.*—Regarding the fittest construction of acid chambers, the total capacity to be allowed to them for the work required, and the number and dimensions of the separate chambers into which that space should be sub-divided, on these points there still prevails the same wide diversity of opinion and practice. Though the work that a given chamber space may be forced to do is so elastic that no definite limit can be assigned to it, it is found in practice that, when chambers are pressed beyond a certain point arrived at by experience, the extra work done by no means compensates for the greatly increased wear and tear, and the larger percentage of nitre required for good condensation. Giving due regard to these considerations, it will be found to be wise economy in the long run to work with a large chamber capacity, by which I mean 3000 to 4000 cubic feet per weekly ton of pyrites. Not only will this result in a considerable saving of nitre, but the *total work* got out of the chambers will be greater than by driving them harder. To work chambers "high press" is only justifiable in certain emergencies, or in cases where it is a more important consideration to keep the capital expenditure low than to seek the greatest economy in working.

The numbers and dimensions of the chambers, found working together as a set, are very various. The single chamber, once so common in the earlier days of lead chambers, is still not unfrequently met with in some places, though, on the Tyne, I am not aware of any instance of it still surviving; and every number from that up to eight or nine working in a series is met with in practice. Chambers are built with lengths varying from 30 feet to 200 feet; breadths, from 20 feet to 50 feet; and heights, from 9 feet to 33 feet. The latter very unusual height has, I notice, been adopted at Stolberg, in Germany.

The theory has been held and defended by some, that the formation of acid is promoted by the surface action of the sides of the chambers, and that therefore we ought to go to the expense of making our chambers very low and narrow, in fact, more like tunnels. I do not know, however, any practical man who now countenances this view. The experiments which appeared at first sight to support it have been shown by some German chemists to be thoroughly fallacious. Neither, on the other hand, can we admit unconditionally that with gases of the same composition and under the same physical conditions of temperature and pressure the acid formed will be simply proportional to the total chamber space, however that may be apportioned. If we could imagine acid making to be conducted in an intermittent fashion (as, I believe, actually took place during the first and most primitive stage in its history), filling a given space with successive portions of the mixed gases, and leaving them at rest till complete condensation, although, under these conditions, this might at first sight appear to be the case, still, even then the form of the condensing space would be found not wholly immaterial. One spherical chamber, or the nearest practical approach to it, say, a cubical chamber, would then, in my opinion, be at once the most economical and the most effective condensing space, because in it the diffusion of the stagnant gases would be least impeded, and the gaseous currents due to condensation would most rapidly effect that complete intermixture of the component gases required for the condensation of the last portions of the sulphurous acid.

But acid making being a continuous process, the gases constantly entering and leaving the chambers, we have to consider in what way this will affect the condensing or acid-forming power of a given space, according to its form. Now, I think we may compare the reactions going on during the passage of the gases through the chambers to the case of one metal precipitating another out of solution; as, for instance, iron and copper in the usual process of copper extraction. In some instances, the liquors containing the copper in solution used to be run continuously through a series of four or more vats filled with scrap iron, depositing their copper completely before running away to waste from the last. This I consider is very analogous to what takes place with the gases of the acid chambers, the copper representing the sulphurous acid, the iron the nitric oxide (N_2O_2) and oxygen, and the waste liquors the residual oxygen and nitrogen gases passing away by the chamber exit. In the first two vats through which the liquor passes strongly impregnated with copper the precipitation goes on very rapidly, but on the bulk of the copper being separated it gets very sluggish, and the liquor requires to traverse several more vats, and to be thoroughly mixed by entering below and overflowing at the top, in order to give the iron time to come into contact with, and precipitate the last traces of copper from the large bulk of waste liquors.

The chamber process may be described in almost identical terms. The gases from the kilns enter the chambers comparatively rich in sulphurous acid, and the production of sulphuric acid by their combination goes on very rapidly. The heat they bring with them and that developed by the chemical action produce an intense molecular activity in the gaseous mixture, and the condensation taking place gives rise to gaseous currents, which alone are sufficient to mix the gases thoroughly. Therefore, at this stage, the production of acid goes on as well in the largest as in the smallest chamber; but with this important difference in favour of the larger chamber, that there is less contact of the gas with the lead per unit of gaseous volume contained in it, and therefore less wear and tear of lead per ton of acid made. But, in the chambers, just as in the copper precipitating vats, the energy of the action abates as the acid is deposited on the floor, the heat and molecular activity of the gases diminish, and when two-thirds, or thereabouts, of the acid has been separated, it is then beneficial to further mechanically the complete mixing of the residual gas by filtering it, so to speak, through three or four smaller chambers. In this way, the remaining attenuated particles of sulphurous acid, forming now only one or two per cent of the whole bulk of gases, by being made to pass out of one chamber into another, are forced to come into intimate contact with the excess of oxygen and nitric oxide, and so oxidised and precipitated from the mass of inert gases.

But though these considerations should dissuade the acid maker from simply constructing the largest chamber space out of the least possible materials, it is nevertheless a very important point for him to consider to what extent he may save lead without impairing the efficiency of his plant. This end will be best attained, I think, by forming the first portion (say one-half or two-thirds) of the chamber

space into two chambers of large capacity, constructed with as much economy of material as possible, and the remainder into three or four much smaller chambers with the view of facilitating complete condensation along with economy of nitre.

On the Tyne chambers will be often found with one-fourth of a square foot of lead for every cubic foot of capacity. This might just as well be reduced to one-fifth of a square foot; with, first, as good working results; second, less wear and tear of lead; and, third, a saving of one-fifth of the whole lead.

Say, for instance, we had to build a set of chambers to take 70 tons of pyrites per week—a very handy size in a large acid plant. Allowing a liberal working capacity of 3200 cubic feet per weekly ton, I would divide the total chamber space somewhat in this fashion into six unequally sized chambers, say:—

2 chambers, each 60'0" long × 50'0" broad × 20'0" high, and
4 „ „ 60'0" „ × 20'0" „ × 20'0" „

giving a total capacity of 216,000 cubic feet, with a total superficial area of 43,200 square feet of lead; or equal to one-fifth square foot of lead per cubic foot capacity. This arrangement of the space would therefore require on the whole 10,800 square feet less lead than the same capacity of chambers constructed with one-fourth square foot of lead per cubic foot capacity. At 7 lbs. to the foot, this would amount to nearly 34 tons of lead, a very considerable item. It might be worth consideration whether the lead thus saved in the superficial measurement might not be expended advantageously in increasing the weight per square foot by one-fourth, which would probably make the life of the chambers at least one-half longer.

I think it is a good thing to keep the chambers rather short, not exceeding 80 feet to 90 feet, in order to apply the steam at shorter intervals in the course of the gas, and thus keep the acid of more uniform strength from one end of the chamber to the other; and also with the view of being better able to control the strength of the acid formed, more especially at those critical points of the series where a too great increase in strength causes it to absorb nitrous gas, and carry it down out of the circulation. When the chambers are very long one or more steam jets must be placed along the side in addition to the one at the end. Otherwise, it will be necessary to keep the acid far too weak at the steam end, in order to prevent its getting so strong at the far end as to become destructive to the lead, or to absorb nitrous gas. There is the same inconvenience in using jets of spray or "pulverised water," as Sprengel's patent recommends to be done. Spray has not the "carrying power" of steam, and would therefore need to be applied in frequent jets along the sides of the chambers—the objections to which are clearly greater than any trifling saving in fuel that may be effected by using only so much steam as is necessary to produce the jets of spray. It appears to me that the best results will be obtained by forming chambers into sets of not less than *five* or *six* in number, the gas passing through all the chambers in succession; and that, to secure the steadiest working and the most complete condensation possible the number may be advantageously increased to *seven* or *eight*. Any chance deficiency in the supply of steam or nitre can then be more easily corrected in time to prevent it affecting the colour of the gases at the exit. Twin sets of chambers are also to be recommended. In this case the gases from two sets of burners pass first through, say, two chambers each, and then jointly through three or four more chambers common to both. By this arrangement the irregularities incidental to working tend to compensate each other.

I do not intend to say much on the rather vexed question of the gaseous reactions going on in the chambers. Working in the usual way with pyrites, as on the Tyne, the gases from the kilns will enter the chambers having about the following composition by volume:—

Sulphurous acid	7·0 per cent
Oxygen	11·5 „
Nitrogen	81·5

It is well known that when these gases meet with steam and nitric acid in the Glover towers and chambers sulphuric acid is produced, and an oxide of nitrogen liberated; which, recovered by absorption in strong sulphuric acid, can be used over again, producing the same effect as the original nitric acid liberated from the nitre. It is also agreed in a general way that this is really effected by the nitric oxide (N_2O_2) taking up oxygen to form a higher oxide, and passing it over in successive portions to the sulphurous acid. But in formulating the exact course of the reactions there is a great diversity of views held by chemists, hinging upon the different oxides of nitrogen which may be represented as taking part in the operation. The chief of these theories may be stated as follows:—

1st Theory.—The immediate agent in the oxidation of the sulphurous acid is to be regarded as nitric acid itself (HNO_3). This acting on the sulphurous acid forms sulphuric acid and peroxide of nitrogen, according to the equation $SO_2+2HNO_3=H_2SO_4+N_2O_4$. The latter is decomposed by the steam into nitric (HNO_3), which acts as before, and nitrous anhydride (N_2O_3), which in its turn is decomposed by steam into nitric acid and nitric oxide (N_2O_2); and the nitric oxide then takes up oxygen from the air present, to reform peroxide of nitrogen (N_2O_4), as represented in the equations—

$$2N_2O_4+H_2O=2HNO_3+N_2O_3.$$
$$2N_2O_3+H_2O=2HNO_3+N_2O_2.$$
$$N_2O_2+O_2 \quad =N_2O_4.$$

2nd Theory.—According to this theory, the reactions going on in the chambers are still more complex, and marked by the formation and immediate decomposition of a peculiar compound or nitro-substitution product of sulphuric acid, commonly known as the "white crystals of the chamber." The steps are represented as follows:—

Nitric acid acting on the sulphurous acid gives, as in the first theory, sulphuric acid and nitrogen peroxide (N_2O_4). The N_2O_4, thus liberated by the first action of the SO_2 on the nitric acid carried into the chamber in the first instance, then becomes the active agent in oxidising further quantities of SO_2. This is owing to its peculiar property of forming by union with SO_2 the crystalline compound just mentioned, which may be represented as $SO_2.NO_2.NO_2$, or sulphuric acid in which the two hydroxyls are replaced by two atoms of NO_2. As according with its mode of decomposition this body is more commonly written $SO_3.N_2O_3$; and, if combined with one atom of sulphuric acid (as it is usually supposed to be in the free state), it will be represented either according to the radical theory as $SO_2.HO.NO_2$, or dualistically as $H_2SO_4,SO_3N_2O_3$. If steam were deficient, the reaction would end with the formation of this body; and with only strong acid lying on the chamber floor it would on falling be dissolved in it, forming what is known as "nitrous sulphuric acid." This, as is well known, actually occurs when there is a deficiency of steam in the chambers. But under normal conditions, with excess of steam present, it is at once decomposed according to the equation $SO_2.NO_2.NO_2+H_2O=SO_2.HO.HO+N_2O_3$. The nitrous anhydride (N_2O_3) set free by the decomposition, in oxidising a further portion of sulphurous acid is reduced to nitric oxide (N_2O_2), which, being again oxidised to N_2O_4 by the excess of oxygen present, is ready to start again with the formation of the crystalline compound.

3rd Theory.—This theory represents the whole operation in a much simpler and, to my mind, more natural manner. Nitric acid and steam acted on by excess of sulphurous acid produce at once sulphuric acid and nitric oxide, $3SO_2+2HNO_3+2H_2O=3H_2SO_4+N_2O_2$. Nitric oxide ($N_2O_2$) is then oxidised in varying proportions into nitrous anhydride (N_2O_3) and nitric peroxide (N_2O_4), according to the greater or less excess of oxygen present in the chamber. And both of these oxides react in a similar way to nitric acid on the sulphurous acid, producing, by the help of steam, sulphuric acid and nitric oxide as before.

4th Theory.—According to this theory, only nitrous anhydride (N_2O_3) is produced even by excess of oxygen acting on nitric oxide (N_2O_2) in presence of sulphuric acid. This last is Weber's theory, and seems to be supported by direct experiments.

Without attempting to decide which of these rival theories is most in accordance with the phenomena observed, I shall pass on and notice two questions in connection with these nitrous compounds which have a practical interest, and would form a very interesting subject for a good chemical paper by some of our members.

The first regards the relative value and accuracy of the various methods employed to determine the nitrate of soda equivalent to the oxides of nitrogen in "nitrous sulphuric acid."

Various chemists have investigated this question, and a good deal has been written and published on the subject from time to time. But still none of the methods usually employed are, in my opinion, above suspicion, and more thorough investigation is required before we can attain the requisite certainty in stating the value of a sample of nitrous vitriol in terms of nitrate of soda. In a paper recently communicated to the Newcastle Chemical Society, Dr. Lunge, of Zurich, has taken up this subject. By using an artificial "nitrous vitriol," produced by dissolving pure nitrite of silver in pure concentrated sulphuric acid of 1·84 sp. gr., and proved to be free from nitrogen compounds, he has shown that very accurate results may be got by the permanganate method, if the usual course is adopted of running the nitrous vitriol from the burette into a measured quantity of permanganate, so as to oxidise the nitrogen compound immediately on its coming in contact with water. If, on the other hand, a measured quantity of the nitrous vitriol is taken, and the standard permanganate run into it, there is always a portion of the N_2O_3 that escapes oxidation by splitting up with the water of the test solution into nitric oxide (which escapes) and nitric acid, before it can be acted on by the permanganate.

No doubt the other oxidising agents that have been used by different chemists for this purpose, such as bichromate of potash, chloride of lime, and hypochlorite of soda, would give equally accurate results in these circumstances. But in proceeding to apply this process, without further concern, to the determination of the nitre equivalent contained in the nitrous vitriol usually obtained in the working of acid chambers, it seems to me that Dr. Lunge has overlooked the sole difficulty of the problem. This I have always regarded as arising from the fact that in ordinary "nitrous acid" we have neither *pure* sulphuric acid, nor, so far as we know for certain, *pure* nitrous anhydride (N_2O_3), as is usually taken for granted. With the exception of the small quantity made from sulphur, nearly the whole of our acid is made from arseniferous pyrites. It is therefore more or less impregnated with arsenic, which so far as it exists in the form of arsenious acid, will affect the titration with an oxidising agent. Then, we are not perfectly sure that there may not be some nitric peroxide (N_2O_4), as well as nitrous anhydride (N_2O_3), escaping from the chambers, and absorbed in our Gay-Lussac acid as such. In fact Winkler has stated, as the results of his experiments, that the former oxide of nitrogen is dissolved by sulphuric acid, though the combination is not nearly so stable as that with N_2O_3; so that, until it is conclusively proved that N_2O_3 is the only absorbable oxide of nitrogen leaving the chambers, this must be another source of fallacy in testing nitrous vitriol by any method based upon the quantity of oxygen required for oxidation. For these reasons it is desirable, I think, to test in some other way the accuracy of these methods in order to ascertain whether, and how far, the results given by them are affected by the causes to which I have referred. This might be done, either by the *ammonia* method, as variously conducted by Schulze, Harcourt, and others, or better, perhaps, by Schlösing's *nitric oxide* method, viz., after oxidising the nitrous vitriol with permanganate, reducing the nitric acid formed, by means of a ferrous salt, to nitric oxide, re-oxidising the nitric oxide over mercury, by means of oxygen and water, to nitric acid, and titrating the latter with standard alkali solution. I should prefer a modification of the latter method adopted by various chemists, which consists in directly measuring the nitric oxide, either over mercury or over concentrated caustic soda solution. Several chemists have, indeed, reported unfavourably of the ammonia method, as not effecting in every case a complete conversion of the nitric acid into NH_3. Dr. Lunge, among the rest, has found, on trying it with both pure nitrates and pure nitrites, that it gave him results falling short of the truth by a large amount. On the other hand, many chemists of repute have declared that the method gives extremely accurate results if conducted with the necessary precautions.

The second question relates to the sources of the loss of nitre in the process. It appears to be well established, by the investigations of various chemists, that there is a partial reduction of nitric oxide in the hot gases of the kilns to nitrous oxide (N_2O), or more probably to nitrogen. Now it would be extremely interesting to know whether and how far this is an invariable source of loss, in the usual way of working, where the hot kiln gases are used to carry the nitrogen compounds into the chambers, or whether it takes place only under certain conditions of heat and concentration of the gases. After answering the first question, and so establishing a thoroughly trustworthy method of valuing "nitrous acid," the loss from this source could be determined most easily in an indirect way, by finding the amounts of nitre lost in the acid run away and in the waste gases, calculating the percentage on the sulphur used, and deducting from the actual percentage of nitre required.

I have little doubt, however, that the loss of nitre in this way is small compared with that due to the imperfect absorption at the outlet of the chambers. It is a well known fact that, even when chambers are in the very best order and working with the usual percentage of nitre, the waste gases appear yellowish in bulk. This is simply because the available packed space in the Gay-Lussac tower is not sufficiently large to search out and absorb all the nitrous gas, in so short a time, from the vast bulk of the diluting gases passing through it. In nearly every instance these towers are built far too small for anything like perfect absorption. It is my experience that, by largely increasing the absorbing space, there is almost no limit to the reduction in nitre that may be effected. Most towers would require to be at least doubled in horizontal area. And if only one-half per cent nitre on pyrites were saved by the operation, it would defray the whole extra cost of the larger tower in one or two years. To make the recovery of nitre as complete as it might be, I think the absorbing space in the Gay-Lussac towers should not be less than 80 to 100 cubic feet per weekly ton of pyrites; and under these circumstances, with a chamber working space of 3000 to 4000 cubic feet, I should expect to work with ¾ per cent to 1 per cent of nitre on the pyrites. While maintaining the height of the tower as at present—aboubt 40 feet to 50 feet—I would add the additional capacity in increased horizontal section, with the further advantage that the coke packing might then be made closer without running the risk of choking the draught.

It has recently been proposed to feed the chambers with nitre in solution, through the Glover tower, or otherwise. This forms the subject of Burnard's patent, though I may mention that the plan was tried five or six years ago, at the Jarrow Works, by Mr. Hill, and abandoned. If otherwise free from objections, it would certainly be a much more regular way of supplying the nitrous compounds; and besides doing away with the unpleasant job of "potting," would avoid the possible loss of nitre by the reduction proceeding too far in the hot kiln gases. But, unfortunately for the success of this would-be improvement on the old way of working, the sulphate of soda thus formed in the acid of the towers crystallises out in the

pipes and cisterns, if it is allowed to cool, and chokes them up. And even if the quantity is not great enough to produce that effect, acid so impregnated with sulphate of soda could not be used for the Gay-Lussac very long without silting up the pores of the coke. This difficulty may, of course, be got over in some measure by keeping one Glover tower fed with the nitre solution alone, and running the hot acid direct from it to the decomposing pans, while another Glover tower, fed only with nitrous vitriol, concentrates acid for the use of the absorber. But this is a restriction on the freedom of working that would often be very inconvenient, and in a small plant, with only one Glover tower, quite impossible. To meet this difficulty the patentee has devised a sort of injector, to carry the mixed acid and nitre solution, by means of a jet of steam, into the first chamber in the form of a *spray*. I learn, from Mr. Rennoldson, who has tried this arrangement at the Tyne Alkali Works, that it was very difficult to adjust the steam-jet so as to convert the liquids into a complete spray, and ensure the nitre remaining long enough suspended in the atmosphere of the chamber to be completely decomposed before falling into the bottom acid. He also found that so much steam was required for the purpose that, together with the steam evaporated from the tower and the water from the nitre solution, the acid of the first chamber got far too weak for use. The patentee claims by this method to have reduced nitre to about 1 per cent on pyrites.

(To be continued.)

NOTICES OF BOOKS.

Artificial Manures; How to Make, Buy, Value, and Use. By Alfred Sibson, F.C.S. London: W. Ridgway.

This work is addressed not to chemists, scarcely to manufacturers of manure in the ordinary sense of the word, but to agents, merchants, and above all to consumers. There are indeed here and there a few hints which may be of value to the analyst; there are tabular views of the average composition of coprolites and other phosphatic minerals, and there are formulæ for the manufacture of mineral superphosphate (in which, by an unfortunate misprint, Cambridge coprolite is stated to contain 5—8 per cent of tribasic phosphate of lime, instead of 58) of bone-manures, bone-ash superphosphate, &c., which will doubtless prove useful to amateur makers and farmers, who mix manures for their own consumption, or perhaps supply a few neighbours. But this practice the author is far from recommending. He points out very justly that the raw materials are quite as likely to be sophisticated as the finished manure, and that the manufacturer's profit depends to a very great extent upon the purchase of phosphatic minerals, &c., on the large scale, upon the production of the acid required, and the use of steam-power in various departments of the process.

Into the valuation of manures the author enters at some length. He considers, indeed, that the consumer or the merchant ought themselves, on receiving the analysis of a sample, to calculate its approximate value, without having recourse to the chemist. So long, however, as the latter is expected to perform this task, he should, at least, bring correct principles to the task. He therefore gives the following scale of prices per unit:—

Soluble phosphate, 4s. 6d.; do. in mineral superphosphate, 4s.; precipitated phosphate, 3s. 6d.; insoluble phosphate of bones or guano, 2s. 6d.; do. mineral, up to 7 per cent, 1s.; potash sulphate, 3s. 6d.; and ammonia, £1.

It is obvious, however, that in valuing manures, a double standard may be applied. There is the strictly agricultural value; the question how much benefit 10 or 20 per cent of any given constituent will bring to the soil; and, on the other hand, the commercial value, the cost of its production. The former of these values is necessarily fixed, since the power of potash, or ammonia, or phosphoric acid in nourishing any particular crop must remain the same whatever may be its market price. The latter, or the commercial value, obviously depends on supply and demand. How these two values may be relatively altered is well seen in the case of peruvian guano. This manure, in its palmy days, as Mr. Sibson shows, contained from 16 to 18 per cent of ammonia, whilst now it has fallen to about 10 or 11, whilst its moisture and its insoluble siliceous matter have undergone a corresponding increase. Its agricultural value has evidently, therefore, fallen, whilst its commercial value has undergone no corresponding change. Formerly it was valued by chemists at more than its selling price, whilst now it is estimated, and less, and is hence evidently a much worse bargain for the farmer than was the case thirty years ago. Mr. Sibson evidently aims at giving the commercial value, since he says: "the following scale is intended to apply to the purchase of manures under the circumstances usually prevailing in agricultural districts where they are supplied in bags, carriage paid, and credit given." Yet he ascribes a lower value to "precipitated" (reduced, or reverted) phosphate than to soluble, though the former must obviously have cost as much in its preparation as the latter. It will be perceived that a higher value per unit is set upon soluble phosphate from recent organic sources than upon that prepared from mineral sources. Yet on p. 42 we read that the soluble phosphate derived from mineral phosphates "is in every respect as good as that obtained from bones." A peculiarity in Mr. Sibson's scale of values is the comparatively low estimate placed upon soluble phosphate. It has been valued by various authorities at £30 to £32 per ton—a more convenient system in our opinion than that of prices per unit. We refer to these points to show the great difficulty involved in attempting to fix upon manures a money value, which shall be satisfactory from every point of view.

The author, we are glad to find does not countenance the delusion—still too widely prevalent—that the profits of the manure-maker are exorbitant. Whatever may have been the case "once upon a time" the competition in the trade permits of no high scale of emoluments, and few departments of business require so much capital, skill, judgment, and energy in proportion to the sums realised. Some instances of adulterated manures are given in the book before us, but it is not intimated that such cases are increasing. Indeed, as far as we have been able to observe, the very contrary is the fact.

To those classes of readers for whom it is more particularly intended Mr. Sibson's work will doubless prove of considerable utility.

*Beer; its Adulterations, and the Means for their Detection.** By Dr. R. Stierlin. Bern: E. Magron.

We have here a very thorough-going and carefully-compiled manual. The author first gives an account of the four normal ingredients used in brewing, to wit, malt, hops, water, and yeast, and protests against all additions and substitutes. He next enters upon the chemistry of fermentation and the practice of brewing. We perceive here that he is not unacquainted with the tricks of the trade. Thus he mentions the English custom of adding salt to malt-liquors for the purpose of increasing the thirst of the drinker, and informs us that in East Prussia *Comarum palustre* is added with the same questionable intent. He points out that the pipes, taps, &c., of the beer-pumps used in taverns are attacked by the liquor, and recommends that the former should be made of pure tin, free from lead, whilst the taps should be coated in-

* Das Bier, seine Verfälschungen, und die Mittel selcke nachzuweisen.

wardly with nickel, which is proof against the dilute vegetable acids present in beer. The possible sophistications of malt-liquors—a very formidable catalogue—are next enumerated, and methods for their detection laid down. Dr. Stierlin premises the very useful caution that beer which has produced unpleasant symptoms in the consumer must not necessarily be supposed to contain poisonous adulterations. If the process of fermentation has failed, or if the liquor is turning sour it may, especially if taken in excess upon an empty stomach, exert a decidedly poisonous action. For proving the physiological action of substances separated out in the course of the analysis, he recommends mice, "for which we need entertain no especial compassion if the experiment succeeds and the subject perishes, and which offer the advantage that the substance in question can be easily recovered from the intestines and from the urine."

The action of any organic base upon the pupil of the eye he ascertains by experiments upon cats. These recommendations, however, are of little value to English chemists, since, according to the peculiar logic of hysterical humanitarianism, they would amount to the sin of vivisection. To give a mouse poison simply for its destruction or for amusement is lawful, but to administer to such an animal a dose of an unknown or doubtful substance, in order to ascertain its nature, is a serious offence without the operator has obtained a special licence from the Home Secretary. Were not inconsistency one of our most cherished national attributes, we should not tolerate an action perpetrated out of pure wantonness, and yet punish it as a crime if performed with a high and important motive. Dr. Stierlin's method consists of the following operations:—Determination of the specific gravity of the carbonic acid (upon which he places only a secondary value), of the alcohol, and of accompanying volatile acid. Determination of gluten, of total solids; of the ash, and of its silicic, phosphoric, and sulphuric acids; of its other constituents. Special examination for injurious metals. Resolution of the extract and search for foreign bitters and alkaloids. Finally, he examines the colouring matters both chemically and spectroscopically.

Such an examination must naturally consume much time, and can only be entrusted to an experienced chemist, but it is idle to expect that all the possible impurities of so complex a fluid can be discovered by a few simple tests.

The most interesting portion of the work consists of the instructions for the detection of substitutes for hops. The author treats the residue obtained on evaporation, first with an acid, and then with ammonia, and subdivides the two portions thus obtained by successive treatment with petroleum ether, benzin chloroform, and metallic alcohol.

The author doubts the alleged use of strychnia as an adulterant of beer, since to impart perceptible bitterness to a litre 0·005 to 0·01 grm. would be required, a very serious dose, especially as the alkaloid would combine with the free acetic acid always present in beer, in which state much of its original bitterness is lost.

Aloes, the use of which, according to Peter Pindar, was suggested by George III., should be sought for not in the beer itself, but in the sediment at the bottom of the cask.

An appendix contains an account of Pasteur's proposed method for excluding from beer during fermentation the germs of all other fungi save the true *Mycoderma vini*, and thus obviating most of the morbid changes to which malt liquors are subject.

We must pronounce Dr. Stierlin's treatise a most valuable addition to the literature of chemistry as applied to food and its adulterations.

It ought to be in the hands of every public analyst and medical officer of health, as well as of every person who is studying the art of brewing.

CORRESPONDENCE.

SPONTANEOUS METAL-GROWTH.

To the Editor of the Chemical News.

Sir,—About twelve years ago I put about an ounce of rolled metallic cadmium (coiled six times) into a clear flint-glass phial, corked it tightly, cut the cork level with the mouth of the phial, and sealed it very carefully. At the time the metal did not quite reach up to the neck of the phial. Since that time it has elongated more than a quarter of an inch, and, during the present year, the sealing-wax has been broken all round and the cork forced outward more than one-eighth of an inch. The cork is even now fairly tight, but the metal follows after it to touching forcibly, and probably the cork will be presently completely forced out.

The cadmium is fast oxidising and endeavouring to uncoil itself, and the cut edges at the bottom of the phial are becoming foliated.

Allow me to ask if your readers have noticed any such spontaneous change in this metal.—I am, &c.,

T. A. Readwin.

Liverpool, April 19, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft, No. 19, December 10, 1877.

Determination of Vapour-Densities.—V. Meyer.—The author describes a greatly simplified apparatus for these determinations, which is essentially the same as that lately described by him to be used with Wood's metal, the latter being replaced, however, by mercury, and the sulphur vapours by those of water, aniline, or ethyl-benzoate. A U-tube, open at one end, contains the substance to be experimented upon, and is filled with mercury. It is then hung in an atmosphere consisting of the vapours of one of the above-mentioned liquids until the mercury ceases to flow out. The weight of the mercury which has been ejected the height of the mercury column in the side tube, temperature, and pressure supply the necessary data for determining the density.

Vapour-Densities of Reten, Fluoren, Stilben, and Chrysen.—W. Knecht.—The author has determined the vapour-densities of these substances by means of V. Meyer's apparatus (with Wood's metal), and obtained results coinciding with the formulæ accepted at present.

Introduction of Nitrogen Radicals into Compounds of the Fatty Series.—V. Meyer.—Diazo-benzene-nitrate, when added to a solution of aceto-acetic-ether in HKO, gives rise to a bright yellow compound melting at 154°, possessing the properties of an acid, and forming yellow finely-crystallised salts. The reaction is—

$$C_6H_5.N_2.NO_3 + CH_3.CO.CHK.COOC_2H_5 + H_2O = KNO_3 + C_2H_5OH + C_6H_5.N_2.CH(COOH).CO.CH_3.$$

This compound is one of the rare instances of the formation of an azo body in the fatty series. A solution of aceto-acetic-ether in caustic potash, when treated with KNO_2 and H_2SO_4, yields at once a new acid,—

$$C_6H_9O_4N, C_6H_{10}O_3 + HNO_2 = H_2O + C_6H_9O_4N.$$

It is a transparent oil, neither miscible with water nor capable of distillation, dissolving in alkalies with a deep yellow colour, and is probably a nitroso-derivative.

Dimethyl-aniline.—W. Michler and A. Gradmann.—Dimethyl-aniline, on treatment with benzyl-chloride, yields dimethyl-phenyl-benzyl-ammonium-chloride,—

$$NCl(CH_3)_2(C_6H_5)(CH_2.C_6H_5).$$

At 220° it changes into the hydrochlorate of the base, $N(CH_3)_2(C_6H_4.CH_2.C_6H_5)$, which is separated on treatment with Ag_2SO_4, and which yields dimethyl-aniline and benzyl-alcohol by dry distillation.

Dimethyl-amido-phenyl-glyoxalic Acid.—W. Michler and U. Hanhandt.—The authors have obtained this acid, $C_6H_4[N(CH_3)_2]CO.COOH$, by the action of dimethyl-aniline on the chloride of ethyl-oxalic acid,—

$$COCl.COOC_2H_5,$$

and saponification of the resultant ether. The ether forms small yellow laminæ, melting at 95°. The acid is similar in appearance, melts at 187°, is soluble in water, and forms crystalline salts. By this method the keton-acids of the aromatic series can be obtained, but in a manner less preferable than that lately discovered by Claisen and by Hübner.

Normal Nitro-butan.—J. Züblin.—The author has made a very complete study of this body, and finds that it possesses the same general properties as the other primary nitro compounds. It is obtained by the action of $AgNO_2$ on normal butyl-iodide as a colourless liquid, lighter than water, boiling at 151°, and possessing slight acid properties. Reduction changes it into normal butyl-amine, the hydrochlorate of which reduces alkaline solutions of Cu, Ag, and Hg salts with great ease. By heating with HCl it yields hydroxylamine and normal butyric acid. With HNO_2 it gives rise to butyl-nitrolic acid, a yellow oil dissolving in alkalies with a bright red colour. Treatment with Br, according to Tcherniac's method, yielded the mono-bromo-derivative, and, according to Myer's method, the dibromo-derivative. The mono-bromo-nitro-butan is a heavy yellow oil, and is changed into dinitro-butan, $C_3H_7.CH(NO_2)_2$, when exposed to the action of HKO and KNO_2. This is likewise a yellow oil, boiling at 190°, and forming crystalline salts with K and Ag, $C_3H_7.CAg(NO_2)_2$. It forms also a mono-bromo-derivative.

Iso-nitro-butan.—A number of derivatives isomeric with the above-mentioned are described. The mono-bromo compound boils at 175°. Iso-dinitro-butan is a yellow oil decomposed on heating. Its potassium salt, $(CH_3)_2CH.CK(NO_2)_2$, gives with bromine-water iso-mono-bromo-dinitro-butan, a colourless mass resembling camphor, and melting at 38°. This salt, in solution with diazo-benzene-nitrate, forms iso-nitro-butyl-azo-phenol, $C_6H_5N..N.CH(NO_2).CH(CH_3)_2$, a yellow oil.

Dichlor-anilines.—F. Beilstein and A. Kurbatow.—Of the six possible isomeric dichlor-anilines but three have hitherto been known. The authors have increased the number to five by obtaining the two amido compounds which are derived from o-chloro-benzene. o-dichlor-aniline, $C_6H_3(NH_2)ClCl$, 1.3.4, results from the action of Cl on the solution of m-chloro-acetanilide in acetic acid and distillation with HNaO, or from the reduction of nitro-o-dichloro-benzene, $C_6H_3(NO_2)ClCl$, 1.3.4. It crystallises in long needles, and melts at 71°. An unsymmetrical trichloro-benzene results from the replacement of the NH_2 group by Cl. o-dichlor-aniline, 1.2.3., is found among the products obtained by the reduction of the higher boiling portions of the reaction-products of Cl on nitro-benzene in the presence of $SbCl_5$. It melts at 23°, and solidifies in large prisms. The consecutive trichloro-benzene is obtained by the replacement of the NH_2 group by Cl.

Determination of the Fat in Butter.—M. Kretzschmar.—The author has tested the method of Hehner, who saponifies the fat of butter with alcoholic potash, and always obtains for pure butter from 85 to 88 per cent of insoluble fatty acids. The last figure is regarded by Hehner as the highest allowable for pure butter. A repetition of his experiments shows that the quantity of fatty acids amounts in cases to 90 per cent; a higher figure shows the presence of adulterations. Among other determinations made of insoluble fatty acids are the following:—

Lard..	95·0 per cent
Castor oil	96·0 „
Human fat	95·3 „

L. Liebermann has repeated the recent experiments of Kosman (*Bull. de la Soc. Chim.*, xxviii.) on the "Transformation of Glycerin into Glycose," resulting from the action of iron-foil, potassium permanganate, or bichromate of potassium, and sulphuric acid on glycerin. He finds that the reduction of Fehling's solution, regarded as the proof of the presence of glycose in the reaction-products, is due to the formation of ferrous oxide, lower oxides of manganese, or chromic oxide, and that no change into sugar takes place.

J. Barsylowsky has obtained "M-Azo-toluen," $C_{14}H_{14}N_2$, by treating m-nitro-toluen with alcoholic potash and zinc. It forms large orange-red crystals, melting at 54°, and completes the series of the three isomeric azo-toluens.

A. Naumann details more particularly his "New Method of Determining Molecular Weights." As already communicated, he has ascertained that when the vapours of one liquid are driven through another liquid—with which it does not mix—the ratio between the quantities of the two liquids in the distillate, expressed in terms of their molecular weights, is equal to the ratio between the tensions of the vapours of the two liquids at the temperature at which the mixture distils. The practicability of this process for the determination of molecular weights may be seen from the following table of experiments carried out with steam. The first column contains the specific weights of the various substances, the second their boiling points, the third the temperature by the distillation with steam, the fourth the ratios between the quantities in the distillate expressed in terms of the molecular weights, and the fifth the ratios between the tensions of the vapours of the two liquids according to the temperature in column three:—

	I.	II.	III.	IV.	V.
C_6H_6.. ..	0·877	79·5°	69·1°	0·410	0·420
$C_6H_6CH_3$..	0·865	108·5	84·0	1·270	1·260
CCl_4.. ..	1·599	76·1	66·7	0·360	0·360
$C_6H_5NO_2$..	1·206	208·0	99·0	38·500	33·30
C_2H_5Br ..	1·407	72·0	37·0	0·064	0·065
$C_7H_5O_2C_2H_5$	1·048	213·0	99·1	49·910	45·99
$C_{10}H_8$ ..	—	218·0	98·8	38·980	36·40

As will be noticed, the slight differences in the last two columns are not sufficient to prevent a perfectly reliable determination as to whether the molecular weight of a body should be doubled or halved, and the new method can be used to advantage in settling many disputes as to the formulæ of organic compounds.

Dibromide of Acetic Acid.—C. Hell and O. Mühlhäuser.—Although bromine and acetic acid do not react on one another in the slightest when brought together, the addition of a minute quantity of CS_2 causes at once a development of heat, and the mixture is changed rapidly into a mass of crystals of the composition $C_2H_4O_2.Br_2$. They form at first orange-coloured tufts of needles, but change on standing into red thick prisms. The compound melts at 36°, is excessively hygroscopic, attacks the eyes, and can be sublimed. Water decomposes it. Other liquids, such as CCl_4 or $CHCl_3$, do not possess this peculiar catalytic action of CS_2, which only can cause the formation of this new molecular compound.

Determination of the Acetic Acid in Vinegar.—C. Jehn.—The author's method, which is designed for rapid technical work, consists in introducing 10 c.c. of the vinegar into a flask, containing an excess of sodium bicarbonate, from which the resultant CO_2 is conducted into a second flask filled with water. The volume of water expelled from this flask is collected in a cylinder which can be calibrated so as to show percentages at once.

Formic Acid.—V. Merz and F. Tibiricá.—The authors prepare this acid by conducting a stream of CO over soda-lime at 200° to 250°. The gas is rapidly absorbed, forming CHOONa, and the process can be used for the technical preparation of the acid as well as for a lecture experiment to show the direct formation of organic substances from inorganic.

Sulphates of Vanadium Tetroxide.—B. W. Gerland.

Incomplete Combustions.—L. Meyer.—The author gives the results of incomplete combustions of gases carried out with varying quantities of H, O, and CO, whirh tend to show the correctness of Horstmann's late deductions as to the absence of sudden changes in the proportion of $H_2O : CO_2$, while the proportions II : CO are gradually being altered.

Action of Hydrocyanic Acid.—O. Wallach.—The author shows that the transformation of chloral into dichlor-acetic acid by the action of CNK is not due to the weak alkaline properties of the latter, but to the presence of free hydrocyanic acid, and that a small quantity of HCN is sufficient to change unlimited amounts of chloral into the acid. The reaction results from the tendency of HCN, as nitrile of formic acid, to decompose water into its components (forming NH_2 and CO and—

$$CO + H_2O = CH_2O_2),$$

combined with the inclination of chloral as an aldehyd to take up an additional atom of O, and its readiness to exchange Cl for H and form HCl. Before these united attractions, the water present in the reaction is decomposed, but the hydrogen and oxygen thus set free are entirely appropriated by the chloral which has the strongest affinity for the two elements. A similar catalytic action of CNH has been noticed in the case of alloxan, and glyoxalic acid, and it is probable that the physiological action of the acid is due to an analogous influence on the oxidising and reducing agencies in the animal organism.

Tribromo-lactic Acid, Bromalide, and β-monobrom-acrylic Acid.—O. Wallach and F. Reincke.—Tribromo-lactic acid, $CBr_3.CH(OH)CO_2H$, is obtained in a crystallised form. It melts at 142°, is easily soluble in water, ether, and chloroform, and attacks the skin violently. The ethyl-ether crystallises in needles. The following bromalides have been obtained:—

$CBr_3CH\begin{matrix}O\\COO\end{matrix}\}CHCBr_3$, melting at 158°.

$CBr_3CH\begin{matrix}O\\COO\end{matrix}\}CHCCl_3$, melting at 135°.

$CCl_3CH\begin{matrix}O\\COO\end{matrix}\}CHCBr_3$, melting at 150°.

$CH_3CH\begin{matrix}O\\COO\end{matrix}\}CHCBr_3$, melting at 97°.

The compound melting at 135° gave on reduction β-monobromo-acrylic acid, $CHBr..CH.CO_2H$. It melts at 116°, and yields a silver salt crystallising in needles.

Substituted Thiamides.—H. Leo.—The author prepares these by the action of H_2S on acid imide chlorides. Benzanilide chloride, $C_6H_5CClNC_6H_5$, gives in this manner thio-benzanilide, $C_{13}H_{11}NS$, crystallising in yellow quadratic plates, and melting at 97°. Heating with PbO or HKO changes it into benzanilid. Fusion alone is accompanied by a development of H_2S, and the resultant body, which crystallises in colourless needles, possesses the composition $C_{27}H_{20}N_2S_2$. Thio-benz-toluidide, and thiacet-anilide were prepared in a similar manner.

Nicotin.—R. Laiblin.—By the action of $KMnO_4$ on pure nicotin in dilute solutions the author obtains an acid, $C_6H_5NO_2$, crystallising in colourless needles, and melting at 227°. Several salts are described, and it is shown to be the body obtained by Huber from the oxidation of nicotin, to which he assigned the formula $C_{10}H_8N_2O_3$.

Fluoranthene.—R. Fittig and F. Gebhard.—The authors have obtained a hydrocarbon, which they name Fluoranthene, from the residues of coal-tar used for the preparation of phenanthren, which appears to be identical with the hydrocarbon, idryl, lately found by Goldschmidt in Styrian petroleum. It is separated from accompanying pyrene by repeated crystallisations of the picrates, melts at 109°, and yields on oxidation a quinone and an acid, $C_{14}H_8O_3$. This crystallises in red needles, melting at 192°, is almost insoluble in water, is changed quantitatively into fluorene on distillation with Zn, and into diphenylene-ketone, on treatment with CaO. It is therefore a diphenylene-ketone-carbonic acid,—

$$\begin{matrix}C_6H_4\\COOH.C_6H_3\end{matrix}\!\!>\!CO.$$

Formation of Ammonium Nitrite.—R. Zoeller and E. Grete.—The authors have carried out a large variety of experiments on the results of the combustion of pure H in pure air, all of which show that the combustion is invariably accompanied by the formation of NO_2NH_4, the quantities being small, but sufficient to give decisive reactions with Nessler's solution.

Nitranilic Acid.—R. Nietzki.—By the action of nitrous acid on hydroquinone at 0°, the author obtains a dinitro-dioxy-quinone, $C_6(NO_2)_2(HO)_2O_2$, to which he applies the name nitranilic acid on account of the analogy with chloranilic acid. It crystallises in long prisms, is exceedingly soluble in water, possesses a strong astringent taste, and forms very insoluble crystalline salts with most metals.

Justus Liebig's Annalen der Chemie,
Band 191, Heft 1 and 2.

Green and Blue Ultramarine.—(Second paper.)—Dr J. Philipp.—In this important communication the author shows that green ultramarine is distinguished from the ordinary blue kind merely by the presence of sodium sulphide.

Sulph-acids of Parabrom- and Parachlor-benzoic Acids.—This essay consists of two distinct parts; one by Dr. C. Böttinger on sulpho-para-brom-benzoic acid with certain of its salts and derivatives, whilst the second, by Th. Collen, treats of sulpho-para-chlor-benzoic acid, with its potassium, sodium, silver, barium, magnesium, zinc, copper, and lead salts.

Communications from the Laboratory of the University of Freiburg, in Breisgau.—These communications consist of a paper by Adolph Claus on the introduction of cyanogen groups into organic compounds, and on the decomposition of organic cyanides. Among the subjects treated of are the behaviour of potassium cyanide with iodallyl, the action of the same cyanide upon monochlor-propylen, methyl-chloracetol, trichloro-butyric ether, trichloracetic ether, monochloro-crotonic ether, tricarballylic acid, crotaconic acid, cyancrotonic acid, and chloromaleïc ether.

Communications from the Laboratory of the University of Halle.—These comprise papers by E. Schmidt and J. Berendes on the "Volatile Acids of Croton Oil," and by W. Heintz, on the "Cause of the Formation of Vinyl-diacetonamin."

Action of Bromacetyl-bromide upon Zinc-methyl and Zinc-ethyl.—W. Winogradow.—The product of the reaction with zinc-methyl is not, as might be expected, a tertiary, but a secondary amylic alcohol, methyl-isopropyl-carbinol. With zinc-ethyl the product is a secondary octylic alcohol.

Studies on the Compounds of the Camphor Group.—J. Kachler.—In this, his fifth paper on the subject, the author treats of the oxidation-products of camphor, of the salts of hydro-oxy-camphoronic acid, of dinitro-bephthylic acid, and its behaviour respectively with sodium amalgam, with tin and hydrochloric acid, with caustic alkali, with hydrate of baryta, and with bromine; also of mono-nitro-

hephthylic acid, and its reactions with tin and hydrochloric acid, and with hydrate of baryta.

On Curarin.—Theodor Sachs.—The author criticises the results obtained by Dr. Preyer in 1865 (*Journal fur Prakt. Chemie*, 98, p. 228), and shows that the crystalline "curarin sulphuricum" of the latter is impure, containing phosphate and carbonate of lime, and is, moreover, almost inert in a physiological point of view. He finds that Preyer's process for the isolation of curarin is impracticable, since curare gives up mere traces of soluble matter when treated with absolute alcohol. Curarin gives with sulphuric acid not a blue colour, as asserted by Preyer, but a red. In crude curare it occurs not as an acetate but a sulphate. With the sodium chloride of platinum curarin gives a bulky faint yellowish white precipitate, which is quickly decomposed, taking a violet colour, the intensity of which keeps increasing.

MISCELLANEOUS.

The Royal Polytechnic.—On Saturday evening last Professor Pepper returned to the Royal Polytechnic. His appearance on the platform of the Lecture Theatre was the sign for an outburst of applause, showing how heartily he is welcomed back to the scene of his former labours. He delivered an instructive Lecture on "The Chemistry of the Sun." The Easter programme of the Institution includes a Lecture, by Professor Gardner, on "Clay and the Potter," which is illustrated by examples of pottery and a potter's wheel, showing the various stages in the production of familiar articles of pottery ware.

NOTES AND QUERIES.

Consumption of Guano, &c.—Can any of your readers give an idea of the average consumption and trade price in England of guano and phospho-guano; also the average consumption of potassic nitrate, sodic nitrate, and ammonic sulphate?—CHEMICUS.

MEETINGS FOR THE WEEK.

MONDAY, April 29th.—Medical, 8.
— Zoological, 1. (Anniversary).
TUESDAY 30th.—Civil Engineers, 8.
— Royal Institution, 3. "On Some Points in Vegetable Morphology," W. T. Thiselton Dyer, M.A.
— Anthropological, 8.
— Society of Arts, 8. "The Progress of Agriculture and Stock-farming in the Colony of Natal," P. C. Sutherland, M.D.
WEDNESDAY, May 1st.—Society of Arts, 8. "The Reforms in House Construction demanded by Sanitary Science," John Balbirnie, M.A.
— Microscopical, 8.
— Public Analysts, 8. "Composition of Honey," J. Campbell Brown, D.Sc. "Recent cases of Diseased Milk," G. W. Wigner. "Recent cases of Diseased Milk," C. Heisch. "Remarks on the work done by Public Analysts during 1877, under the Sale of Food and Drugs Act," G. W. Wigner.
— Royal Institution, 2. (Annual Meeting.)
THURSDAY, 2nd.—Royal 8.30.
— Royal Society Club, 6.30.
— Royal Institution, 3. "On Colour," Lord Rayleigh, M.A.
— Chemical, 8. "Chemical Aspect of Vegetable Physiology," Sidney H. Vines.
FRIDAY 3rd.—Royal Institution, 9. "Polarised Light: a Nocturne in Black and Yellow," William Spottiswoode, LL.D.
— Society of Arts, 8. "The Telegraph Routes between England and India," Major Bateman-Champain, R.E.
— Geologists' Association, 8.
SATURDAY, 4th.—Royal Institution, 3. "On Richard Steele," Prof. Henry Morley.

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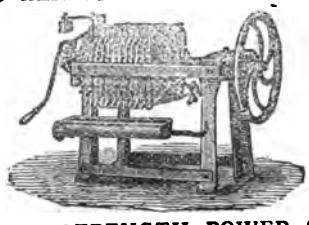

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 962.

THE CONSTITUTION OF MALT LIQUORS, AND THEIR INFLUENCE UPON DIGESTION AND NUTRITION.*

By J. J. COLEMAN, F.I.C., F.C.S.

A LIQUID resembling in appearance British porter, and labelled malt extract, has been sent to us from Germany pretty freely during the last few years. Our esteemed President (Dr. Andrew Fergus) brought it under my notice about 12 months ago, and acquainted me with the fact of its having—in many cases coming under his own observation—proved of service in restoring the energies of individuals suffering from faulty nutrition. Suffering at that time from an attack of illness which had not only reduced strength, but brought on extreme exhaustion from inability to appropriate food, I tried the effect of Hoff's malt extract, in the usual dose of a wineglassful twice or three times a day. Its use was followed by marked effects:—(1.) Food which had hitherto been found to pass the alimentary canal unchanged digested properly. (2.) There appeared an increased power of evolving animal heat and storing up fat.

Passing beyond my personal experience, I have experimented with it in other directions, particularly upon thin, cold, and aged people, who are unanimous in attributing to the liquid sustaining powers which are not commonly observed with alcoholic liquors.

It was therefore with considerable interest that I undertook its chemical examination. The mean result of a number of analyses showed it to consist of—

Alcohol	4·00 per cent.
Extractive matter	8·12 ,,
Water	87·88 ,,
	100·00

On evaporating to dryness and incinerating there was obtained of ash residue 0·05 per cent calculated upon the liquid.

The preparation is therefore a variety of porter or beer, as will easily be seen from reference to the analyses of a number of well-known beers. In appearance, however, it resembles porter rather than beer.

	Alcohol.	Extract.	Water.	Authority.
Hoff's malt extract ..	4·00	8·12	87·88	Coleman.
Royal Bavarian Bock beer..	4·00	7·20	88·80	Kaiser.
Royal Salvator ditto	4·20	8·00	87·80	Ditto.
London beer	4·50	5·00	90·50	Average.
London porter	4·00	4·50	91·50	Ditto.
Edinburgh ale	4·41	3·58	92·01	Paul.

In fact it reminds one of the Royal beers of Bavaria, the analysis of which it closely resembles. These beers were very lovingly dwelt upon by Liebig, who uses the following words:—"The beers of England and France, and for the most part those of Germany, become gradually sour by contact with the air. This defect does not belong to the beers of Bavaria, which may be preserved at pleasure in half-full casks without alteration in the air. This precious quality must be ascribed to a peculiar process employed for fermenting the wort,—that is, fermentation from below, which has solved one of the finest chemical problems." Without committing myself to any hypothetical views upon the nature of the process which has evolved the product, or as to its identity or non-identity with these celebrated Bavarian beers, it may be remarked that the liquid imported varies a little in its tendency to turn sour; sometimes it will not do so if exposed for weeks; other samples have turned sour with but slight exposure.

Referring again to the analysis of the liquid, there are two points to which I wish to direct attention:—The word "malt extract" is, by common consent of chemists, applied to that portion of a malt liquor which either has not been fermented into alcohol, or which after fermentation has *escaped* conversion into alcohol. Further, malt extract is a solid, and is obtained by evaporating the liquids containing it to dryness. It will be seen, therefore, that Hoff's liquid is something more than "malt extract," for it contains, besides this body, alcohol, and the usual quantity of carbonic acid gas, which causes any ordinary fermented liquor to froth up when liberated from the bottles containing it. In fact, the presence of large quantities of carbonic acid gas in Hoff's liquid shows that its alcohol has been produced by internal fermentation. But, on the other hand, this liquid of Hoff's produces, on evaporation to dryness, an extract which differs from the solid extract usually obtained from British beers. Malt extract obtained from such sources contains a large percentage of crystallisable sugar, whilst that from Hoff's liquid is almost entirely constituted of the dark brown uncrystallisable extractive matter present, but in less proportion in the beers of this country.

It will therefore be convenient to call this preparation merely Hoff's liquid, rather than lead to confusion by retaining the name it is commonly known by.

With the information gained by its analysis the question arises—To what constituents of Hoff's liquid are to be attributed its marked physiological effects? There are no doubt some people who will be inclined to say that the value of the liquid is its contained alcohol; there are no doubt others who would strenuously deny this. The question of the nutritive value of alcohol has been ably dealt with by—amongst others—two very distinguished men, viz., Dr. B. W. Richardson, F.R.S., and Dr. Edward Smith, F.R.S.,—not from a theoretical standpoint, but from that of laborious experiment.

Dr. Edward Smith administered, either to himself or one of his assistants, weighed quantities of food selected from the fatty, the starchy, or the albuminous articles of diet. He carefully noted the effect of these varied foods upon the function of respiration; that is—taking hold of the well-established principle that animal heat is produced by the oxidation of food by means of air drawn into the lungs—he collected and analysed the products of respiration, with the view to ascertain to what extent and how soon the carbon of the food is eliminated from the lungs in the form of carbonic acid.

It would be out of the question quoting all Dr. Edward Smith's results, which have been embodied in a number of papers read to the Royal Society; but this is what he says about brandy:—"1½ ounces of excellent brandy, diluted with 6 ounces of water, caused an average *decrease* of 0·2 grain in the carbonic acid expired per minute." In another experiment the average *decrease* was 0·38 grain. The quantity of air inspired fell 42, 37, and 34 cubic inches per minute in different experiments.

In regard to whisky he remarks—"1½ ounces of whisky containing 45 per cent of alcohol, in 6 ounces of cold water, caused an average decrease in the air expired of 0·33 grain per minute."

Let us compare these results with what was obtained from the same weight of sugar. He says—"1½ ounces of sugar dissolved in water gave a maximum *increase* in the carbonic acid evolved of 2·18 grains per minute, and an increase in the air inspired of 111 cubic inches per minute." We are thus shown that if by food is to be understood substances that act as fuel to the system, by being burnt into carbonic acid and water, then *no* chemical evidence can be obtained that alcohol has a right to be called food.

* A Paper read before the Philosophical Society of Glasgow, April 17, 1878.

Turning now to the evidence of Dr. Richardson. He says—"It would be impossible for me to recount the details of the long researches extending with intervals over three years, and which were conducted in my laboratory, to determine the influence of alcohol upon animal temperature. The facts obtained may be epitomised as follows:—The first effect of taking alcohol is the stage of excitement, viz., a rise of temperature of about half a degree, especially on the cutaneous surface. This might be considered as due to the combustion of alcohol; it is not so—it is, in truth, a process of cooling. During this stage, which is comparatively brief, the internal temperature is declining, and the reddened skin is so far reduced in tone that cold applied thereto increases the suffusion. It is this most deceptive stage which leads old observers into the error that alcohol warms the body. In the second stage the temperature first comes down to its natural standard, and then declines below what is natural. In man this fall is represented by three-fourths of a degree. During the third stage the fall in temperature rapidly increases, and amounts in man to as much as 2½°, and in birds to fully 5½ per cent. There is always during this stage a profound *comâ*, and whilst this lasts the temperature continues reduced. The sleep of apoplexy and the sleep of drunkenness may be distinguished by a marked difference in animal temperature. In apoplexy the temperature of the body is above, in drunkenness below, the natural standard of 98°." What, exclaims Dr. Richardson, is the inference? "It is that alcohol is not burned after the manner of food which supports animal combustion, but that it is decomposed into secondary products by oxidation, at the expense of the oxygen which ought to be applied to the natural heating of the body."

This concensus of evidence, coupled with the general experience that the so-called warming-up effects of a dose of alcohol, when taken upon an empty stomach, is followed by a reaction in about forty minutes, go far to prove that the *permanent* warming-up effects of Hoff's liquid cannot be owing to its contained alcohol. But supposing alcohol is not a direct food, may it not be a fat-forming food? This question has been dealt with by Dr. Richardson. He remarks, in his Cantor Lectures, "Notoriously ale and beer fatten, but this fattening may not be due to the alcohol itself, but to the sugar or starchy matters which are taken with it.

Dr. Richardson evidently sees a difficulty here, *but* offers an *insufficient* explanation. In the latter part of this paper I will show how the difficulty can be got rid of, but meanwhile note what he says:—"Alcohol, when it is largely taken, unless the will of the imbiber is very powerful, is wont to induce desire for undue sleep, or at least desire for physical repose. Under such circumstances there is an interference with ordinary nutritive processes. The wasted products of nutrition are imperfectly eliminated, the respiration becomes slower and less effective, and there is set up a series of changes tending independently of the alcohol as a direct producer of fat to development and deposit of fatty tissue in the body. Now this storing up of fat referred to by Dr. Richardson, which occurs with those who abuse alcoholic liquors, is a very different matter to the healthy nutrition which exists by one who has benefitted by drinking Hoff's liquid in small doses, or from the daily swallowing of a glass of London porter. *There is* a distinct nutritive effect produced in some cases of this kind which cannot be attributed to the influence of the alcohol contained in the liquid. I have heard married ladies declare that whilst suckling their strength would have succumbed had it not been for the sustaining effects of a bottle of porter taken daily. Evidence of this kind, which I believe is very common, is most important. The maternal instinct is far too strong to leave in doubt a problem which so materially affects the welfare of her offspring. I am not going to argue that fatness is to be considered in all cases a desirable condition; but the very appearance of a score of beer-drinking Englishmen, as compared with an equal number of whisky-drinking Scotchmen, is an indication of some specific effect which malt liquors have upon nutrition. Going a step further in this enquiry, let us ignore the evidence of Dr. Edward Smith and Dr. Richardson. We have no right to do so, but for the moment let it be admitted that alcohol is a food. Let us take typical cases, on the one hand, of a person imbibing a tumbler of porter every day; on the other hand, of a person swallowing Hoff's liquid daily, in accordance with the direction upon the label. The alcohol contained in the daily dose of Hoff's liquid will weigh about 100 grains; the extractive matter will weigh 200 grains. Without going into the minutia of chemical calculation, it may be stated that these substances contain about half their weight of carbon. Now, what proportion does this 150 grains bear to the total carbon consumed per day by an average man? Liebig, Playfair, and others have given us data. An average man consumes from 4000 to 6000 grains of carbon per day, so that the quantity contained in the daily dose of Hoff's liquid does not amount to more than 3 per cent of one's ordinary daily diet. In the case of a tumblerful of London porter containing, say, 4 per cent of alcohol and 5 per cent of extractive matter, the contained carbon would amount to about 200 grains, or about 4 per cent of an average day's diet. But a more familiar illustration may be offered—the whole of the food value of a glass of porter cannot exceed the weight of sugar equivalent to its alcohol or extractive matter, or about 1 ounce, whilst most people consume 3 ounces of sugar daily, employed in sweetening tea, coffee, and puddings or fruits.

These figures, if we are to believe Drs. Smith and Richardson, are too favourable; but, even in the form I have just given them, they are utterly insufficient to account for the marked physiological effects produced by the liquids I have referred to. These effects are frequently the sensation of being lifted from a feeling of semi-starvation to the condition of being effectually warmed and nourished, and are inexplicable from a chemica analysis of the liquids.

But, although these liquids have no food value of any importance, may they not have the power of influencing the digestion of *other food?* If the extractive matter of beer and porter be really malt extract, that is if it possesses the qualities of original malt, then the question is answered affirmatively. It is well known that if lukewarm water be poured upon fresh bruised malt a certain principle dissolves, which from the difficulty of separating it in the pure state has hitherto evaded chemical analysis. This substance, called diastase, is a ferment, being capable of converting an indefinite quantity of insoluble starch, through the stages of soluble starch and dextrin into the final product glucose or grape sugar. The brewer knows perfectly well that one part of malt contains sufficient diastase to render soluble and convert into grape sugar the starch of four or five times its weight of barley. Indeed, the first stage of brewing beer or porter—viz., the preparation of the wort—is simply converting by the aid of diastase a certain quantity of starch into sugar, which dissolves in the warm water of the mash, and is then converted into alcohol by the process of fermentation by the yeast cell. When the starch has become entirely converted into sugar—an operation which requires that the temperature shall not exceed 180°—then the wort is raised to the boiling-point, the hops at the same time being added. The object of this operation is stated in our text-books to be, first, the destruction of the diastase which has served its purpose; secondly, the precipitation of albuminous compounds likely to interfere with the keeping qualities of the beer. The diastase is believed to be destroyed at the boiling temperature, and the liquid ready for a new fermentation by the agency of yeast—at least as soon as it cools down to the proper temperature for the second fermentation. Hence it might be concluded, *a priori*, that it is impossible for malt liquors, as sold to the public, to contain diastase. It may be so; but the nature of these ferments are very obscure. It occurred to me that the extractive

matter of our ordinary malt liquors might contain the element of a ferment in some latent form, ready to be called into activity during the process of digestion.

The importance of such an agent may be estimated when it is considered that starch forms so large a proportion of the diet of man that in its natural state, or even when boiled, it is not soluble in the sense of being capable of absorption through a membrane (although it may become pasty or sticky), and that before it can be absorbed by the assimilative organs it *must* become soluble.

Starch constitutes 47·4 per cent of wheaten bread, 58·4 per cent of oatmeal, 18·8 per cent of potatoes, 66·3 per cent of wheaten flour, 79·1 per cent of rice, and 82 per cent of arrow root, so that the whole matter seems of sufficient importance to merit careful experiment. It is obvious that, if malt liquors exert a solvent action upon starch, the phenomena can be investigated external to the stomach, provided the necessary temperature and other conditions of the animal digestion be imitated. Such experiments have been conducted not only with Hoff's liquid, but with ordinary beers and porters.

The general method of procedure was to digest weighed quantities of bread or potatoes with measured quantities of the liquid I wished to examine, at blood heat, for the required number of hours it was determined the experiment should last; fresh water was then added, to bring the bulk of the original mixture exactly to its initial measurement; the semi-fluid liquid was then either filtered or dialysed, and a fractional part evaporated to dryness, or examined in other ways to determine the total solids dissolved. Simultaneously with each determination a blank experiment was made with pure bread or potatoes and water, so as to ensure comparisons being made under precisely identical conditions.

The latter precaution was especially necessary, as scarcely two samples of bread are alike as to their soluble constituents. By digesting ordinary bread two or three days with warm water it becomes soluble to the extent of 10 or 15 per cent, and in a short time becomes slightly putrid. Under such circumstances it is not unusual for the starch to become partially soluble by contact action with the decomposing gluten.

This fact was borne in mind most carefully from the very first, and in fact made the blank experiments absolutely necessary every time a fresh comparison had to be made.

Some of the experiments were conducted with ordinary beers and porters, as bought from neighbouring public-houses; but I am indebted to the courtesy of Messrs. Bass and Co., Messrs. Allsopp and Co., Messrs. Truman, Hanbury, and Co., and Messrs. Bates and Co., for samples sent me direct from their respective breweries.

SERIES I.

Fifty grms. of bread were digested at blood heat for six hours with 250 c.c. of water, and then dialysed into 500 c.c. of water. A fractional portion of the dialysed fluid was evaporated to dryness, to determine the total solids, and another portion was examined volumetrically for glucose by the cupric test. This formed the blank bread experiment.

	Total Solids. Grms.	Grape Sugar. Grms.
A. Blank bread experiment yielded ..	1·10	0·40
B. 60 grms. of Hoff's liquid yielded, by dialysing with the same quantity of water	1·10	0·36
Sum	2·20	0·76
A and B mixed together, and then treated as in the blank experiment	2·20	0·69
A and B mixed together, treated as in the blank experiment, but with the addition of a few drops of hydrochloric acid	2·20	0·68

These experiments were made simultaneous in five separate dialysers, and under exactly similar conditions, but the results did not give me any encouragement. They are, however, interesting in one point of view—they show what a small amount of crystalloids can be obtained from the dialysis of bread and water.

For a second series of experiments mashed potatoes were used, but in place of using Graham's dialyses, through the membranes of which dextrin will scarcely permeate, the semi-fluid masses were simply thrown upon a filter, no difficulty being experienced in getting perfectly clear filtrates.

SERIES II.

One hundred grms. of mashed potatoes were digested for six hours, at blood heat, with 500 c.c. of water, and then filtered; a fractional part of the filtrate, after dilution to the original bulk, being evaporated to dryness, for the purpose of estimating the dissolved solids.

	Grms. of Dissolved Solids.
A. Blank experiment, conducted as above, yielded	4·86
B. 60 grms. of Hoff's liquid yielded	5·00
Sum	9·86
A mixed with B, and treated as in the blank experiment	9·66
A mixed with B, and treated as in the blank experiment, but with a few drops of HCl extra	9·56

The results were again negative, and the matter was laid aside for some months. It then occurred to me that in all these experiments the conditions represented stomachic, but not intestinal, digestion. The digestion of the stomach is always effected by secretions which are acid, and it is essentially a peptic or albuminoid digestion.

With the exception of such action as may ensue from contact with the saliva, the starchy matters of the food in great part pass through the stomach unchanged, and do not become digested until they pass that organ and come in contact with the pancreatic and intestinal juices, which are always alkaline. Bread has generally an acid reaction sufficiently distinct to affect litmus. Malt liquors are invariably and still more decidedly acid, so that, independently of the acid purposely added in some of my experiments, there must have been in all cases a decided acid reaction. It was therefore determined to commence these experiments anew, and with a slight alkaline reaction, as similar as possible to that of the saliva or pancreatic juice.

SERIES III.

Fifty grms. of bread were digested, at blood heat, with 200 c.c. of water, made faintly alkaline with sodic hydrate. The total dissolved solids were then estimated after digestion for six hours at blood heat, and filtration in the usual way.

	Dissolved Solids in Grms.
A. Blank experiment, yielded..	6·00
B. 60 grms. of Hoff's liquid, exactly neutralised, yielded	5·51
Sum	11·51
A and B mixed together, and subjected to the conditions of the blank experiment, yielded	16·33

For the first time I had clear evidence of the correctness of my surmises: 4·82 grms. of the bread became soluble by the agency of the Hoff's liquid, or about 20 per cent of its constituent starch.

A portion of the semi-fluid masses were also dialysed, with the following results:—

	Grms.
A contained of grape-sugar	0·26
B „ „	0·39
Sum	0·65
A and B mixed together, and treated as in the blank experiment, yielded of grape-sugar	0·98

Series IV.

Thirty grms. of bread were digested, at blood heat, for five hours, with 300 c.c. of water, made faintly alkaline, filtered, and the dissolved solids determined.

	Dissolved Solids in Grms.
A. Blank experiment, conducted as above	3·24
B. 180 grms. of public-house beer, made neutral and evaporated, yielded	13·54
Sum	16·78
A mixed with B, and treated as in the blank experiment, yielded	19·00

It appears therefore that ordinary beer possesses a solvent power similar to that of Hoff's liquid, but to an inferior degree.

Series V.

Thirty grms. of bread were digested for twelve hours, at blood heat, with 300 c.c. of water, made faintly alkaline, filtered, and the dissolved solids determined.

	Dissolved Solids in Grms.
A. Blank experiment, conducted as above, yielded	6·22
B. 90 grms. of Hoff's liquid, made neutral and evaporated, yielded	7·50
Sum	13·72
A and B mixed together, and treated as in the blank experiment, yielded	20·73
A. Blank experiment, conducted as above, yielded	6·22
D. 180 grms. of beer from a public-house, made neutral and evaporated, yielded	13·54
Sum	19·76
A mixed with D, and treated as in the blank experiment, yielded	23·30

In these experiments it is demonstrated that, with twenty-four hours' digestion, 90 grms. of Hoff's liquid dissolved 50 per cent of the starch of 30 grms. of bread, and that it requires four times as much beer to effect the same result.

Series VI.

Public-house bottled porter, examined in the same way, indicated six parts to be equivalent in solvent power to one part of Hoff's liquid. This porter contained, however, only 4·7 per cent of extractive matter.

These experiments were satisfactory. The quantity of sodlc or potassic hydrate added in each experiment was very minute, and regulated with the utmost care, to avoid communicating an alkalinity more than sufficient to imitate the natural alkalinity of the saliva. It was, however, thought advisable to eliminate doubts on this head by a series of experiments in which the alkaline reaction was established by bicarbonate of soda or tribasic phosphate of soda.

Series VII.

Thirty-two grms. of bread were digested for twenty-four hours, at blood heat, with 300 c.c. of water, made alkaline by 1 grm. of bicarbonate of soda and ½ a grm. of tribasic phosphate of soda; then filtered, and the dissolved solids determined.

	Dissolved Solids in Grms.
A. Blank experiment, conducted as above, yielded	8·16
B. 90 grms. of Burton ale, neutralised and evaporated, yielded	11·50
Sum	19·66
A and B mixed together, and treated as in the blank experiment, yielded	21·80
A. Blank experiment, as above, yielded	8·16
C. 90 grms. of London porter, neutralised and evaporated to dryness, yielded	7·66
Sum	15·82
A mixed with C, and heated as in the blank experiment, yielded	21·81
A. Blank experiment, as above, yielded	8·16
D. 90 grms. of Wrexham ale, neutralised, yielded	7·20
Sum	15·36
A mixed with D, and treated as in the blank experiment, yielded	19·20
A. Blank experiment, as above, yielded	8·16
E. 90 grms. of Hoff's liquid, neutralised and evaporated, yielded	7·30
Sum	15·46
A mixed with E, and treated as in the blank experiment, yielded	23·80

These experiments indicate as follows, the figures being calculated to avoid decimals, and to show the amount of starch in the bread, which became soluble by the agency of the various liquors, the bread used in each case being of the same weight.

The Burton ale dissolved	15	per cent	of the starch.
The London porter „	40	„	„
The Wrexham ale „	26	„	„
Hoff's liquid „	60	„	„

In an eighth series of experiments it was determined to eliminate all sources of error existing from the action of reagents upon gluten, by using pure starch, which would indeed have been used earlier had it not been that this investigation was purposely undertaken to solve a dietetic problem, the conditions of which are not the swallowing of pure starch.

Series VIII.

Fifteen grms. of starch mixed with 300 c.c. of boiling water, so as to form a uniform paste, was made faintly alkaline with 3 grms. of bicarbonate of soda, and digested at blood heat for twenty-four hours. The pasty mass was then diluted with water to 600 c.c., and thrown upon a close filter of thick white paper. A fractional portion of the filtrate, which was brilliantly clear, was evaporated to dryness.

	Dissolved Solids in Grms
A. Blank experiment, conducted as above, yielded	5·18
B. 60 grms. Burton ale, neutralised, yielded ..	8·00
Sum	13·18
A and B mixed, and treated as in the blank experiment, yielded	14·60
A. Blank experiment, conducted as above, yielded	5·18
C. 60 grms. of London porter, neutralised, yielded	4·28
Sum	9·46
A and C mixed, and treated as in the blank experiment, yielded	15·01

This last series of experiments is conclusive, and forms a fitting termination to this stage of the investigation, which has established a food value for malt liquors not generally understood. Chemically of course it is interesting to know into what substance or substances the starch is transformed—whether into ordinary dextrin, Bechamp's soluble starch, Dubunfrants's maltose, or ordinary glucose.

These are questions I do not propose at present going into; but it may be remarked that the dissolved solids partook more of a gummy than a saccharine character. Neither have I been able to fix the limits of the reactions with any degree of certainty; but it is clear—and this physiologically is of the utmost importance—that there is a powerful solvent action exerted by all malt liquors that I have examined, which, with the peristaltic and other muscular action of the digestive organs, has probably been but poorly imitated by the laboratory experiments that have been undertaken.

Another very interesting point came out in this enquiry, viz., that it was not the richest ales coming from our large breweries which afforded the best result, which may be explained in two ways—either from the fact that in large breweries the diastase of malt is made to go as far as possible, by using raw grain with the original malt, or, secondly, as suggested by my friend Dr. Wallace, from the excess of alcohol in strong ales precipitating the diastase before it reaches the consumer.

Before concluding this paper I must remark that the possibility of malt, in virtue of its diastase, becoming a useful article of food was discussed many years ago. It was supposed that cattle could be made to assimilate their food better and fatten quicker by mixing with their ordinary diet a certain percentage of malt. Mr. J. B. Lawes conducted very elaborate experiments for the Board of Trade, in 1866, on the relative values of unmalted and malted barley for stock. These experiments showed that, with healthy stock, the addition of malt to their food produced no more increase of weight than the addition of barley to which the malt was equivalent. But this is what might reasonably be expected. In a healthy state neither man nor animal requires more digestive solvent than what is supplied naturally. But unfortunately a large percentage of our fellow-men, especially the inhabitants of cities, are not in a perfect state of health; nay, more, vast numbers—from the wear and tear of life—are habitual dyspeptics, so that an innocent aid to Nature is sometimes a daily necessity. On the other hand, there are many people whose tendency to develop fat, or secrete sugar in the form of diabetic urine, indicates at once that Nature requires no assistance by the aid of such a ferment as diastase.

ON A NEW METHOD FOR THE SEPARATION AND SUBSEQUENT TREATMENT OF PRECIPITATES IN CHEMICAL ANALYSIS.*

By F. A. GOOCH.

THE introduction of Bunsen's method of filtration and immediate ignition of precipitates in the moist condition has left little to be desired as regards accuracy of result and rapidity of execution, in the treatment of precipitates which may be submitted to high temperatures in contact with carbonaceous matter. In analytical methods which require that filter-paper and precipitate shall be ignited apart, or dried together at a temperature below the point at which paper begins to char, the same degree of exactness has not, in general, been hitherto attained.

To obviate the difficulty of bringing a paper filter of ordinary dimensions, particularly when covered with a voluminous precipitate, to a definite condition of desiccation, the sand filters of Dr. Gibbs and Taylor,* the porous cones of Munroe,† and finally the process of reverse filtering, first applied to qualitative work by Carmichael,‡ improved by Casamajor,§ and thoroughly elaborated by Professor Cooke,‖ have been successively brought forward.

The latter process gives most excellent results in the separation of precipitates which settle quickly and completely; and, inasmuch as many precipitates which of themselves are not inclined to fall rapidly may be made to do so by proper treatment (by boiling, for example, the addition of ammonium salts, Chatard's¶ method of granulating gelatinous precipitates, or other similar device), the field of usefulness of this process is wide.

The sand-filters in skilful hands, and the porous cones with no more than ordinary care, give accurate results, and possess, moreover, the advantage of being applicable to the filtration of liquids which quickly destroy woody fibre. The length of time required to dry them thoroughly, and their sensitiveness to atmospheric conditions, are their great drawbacks.

For the simple filtration of corrosive liquids without reference to a subsequent estimation of the precipitate, filters of sand, broken glass, garnets, and fibrous asbestos have for a long time been used. More recently, asbestos has been moulded into the shape of an ordinary filter: in the dry state by Löwe,** by rubbing between a hollow and solid wooden cones; in the wet state by Gruner,†† by grinding asbestos, mixed in a mortar with water, to a pulp, transferring the mixture to a funnel choked with asbestos, inserting an accurately fitting cone of brass gauze, which presses the asbestos against the walls of the funnel, pouring off the water, carefully removing the cone and drying the layer of asbestos which adheres to the glass. Böttger‡‡ has used filters of gun-cotton; and Bunsen§§ has devised a filtering apparatus for corrosive liquids to be attached to his pump, which consists of a disc of artificial pumice fitted to a conical tube and packed around its edge with fibrous asbestos.

None of these later-mentioned methods, however, are well adapted to the quantitative estimation of precipitates.

Impressed with the desirability of further improvement in those processes of quantitative analysis which involve the use of dried filters, or the separation of filter and precipitate before ignition, I have had the good fortune, in taking the matter up in turn, to succeed in devising and preparing a felt of anhydrous asbestos, which is capable of filtering liquids with a rapidity and efficiency at least as great as may be obtained by the use of good filter paper; is light, compact, incombustible at the highest temperatures used in analytical processes; is not acted upon by acids (excepting hydrofluoric acid) or alkalies; if sufficiently coherent to resist entirely the disintegrating action of a liquid forced through it under the pressure of the Bunsen pump, and which may moreover be prepared by a very simple process: in short, a filtering material which, in my belief, makes it possible to reach a high degree of accuracy in many analytical processes which hitherto have been none of the best, and to add to those already known new methods which previously have been impracticable.

My mode of preparing and using the asbestos felt is as follows:—

First. White, silky, anhydrous asbestos is scraped to a fine short down with an ordinary knife-blade, boiled with hydrochloric acid to remove traces of iron or other soluble matter, washed by decantation, and set aside for use.

* Read before the American Academy o Sciences, Feb. 13, 1878.

* *Am. Jour.* [2], vol. xliv., p. 215.
† *Am. Jour.* [3], vol. i., p. 1.
‡ *Zeitschr. f. Chem.* [N.F.], Bd. 6, p. 481.
§ *Am. Chem.*, vol. v., p 441.
‖ *Proc. Am. Acad.*, vol. xii., p. 124.
¶ *Am. Jour.* [2], vol. i., p. 247.
** *Dingl. pol. Jour.* cxlviii, 444.
†† *Jahresb. Chem.* 1869, p. 990.
‡‡ *Dingl. pol. Jour.* clv., p. 463.
§§ *Ann. Ch. Pharm.* cxlviii., p. 290.

Secondly. A platinum crucible of ordinary size, preferably of the broad low pattern (Fig. 1), is chosen, and the bottom (Fig. 2) perforated with fine holes (the more numerous and the finer, the better) by means of a steel point; or, better still, the bottom may be made of fine platinum gauze. Next, a Bunsen funnel of the proper size is selected, and—following Munroe's plan for holding his porous cones—over the top a short

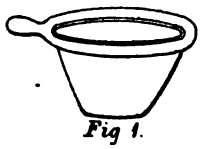


Fig 1.

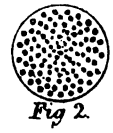


Fig 2.

piece of rubber tubing is stretched and drawn down until the portion above the funnel arranges itself at right angles to the direction of the stem. Within the opening in the rubber, the perforated crucible is fitted as shown in figure 3, and the funnel is connected with the receiver of a Bunsen pump or other exhausting apparatus in the ordinary manner.

To make the asbestos felt, the pressure of the pump is applied, and a little of the asbestos prepared as described, and suspended in water, is poured into the crucible. The rubber and the crucible are held together by the pressure of the vacuum-pump with sufficient force to make an air-tight joint; the water is drawn through, and the asbestos is deposited almost instantly in a close compact layer upon the perforated bottom; more asbestos (if necessary) in suspension as before being poured upon the first, until the layer becomes sufficiently thick for the purpose for which it is intended. Finally, a little distilled water

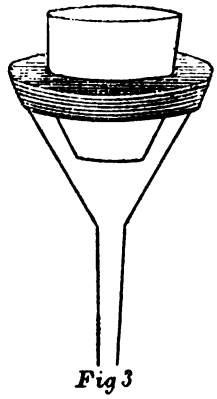


Fig 3

is drawn through the apparatus to wash away any filaments that might cling to the under side, and the filter is ready for use: the whole process occupying less time than is necessary to fold and fit an ordinary paper-filter to a funnel.

To prepare the filter for the estimation of a precipitate, the crucible with the felt undisturbed is removed from the funnel and ignited. In case the precipitate, to be subsequently collected, must be heated to a very high temperature for a long time, it is better to enclose the perforated crucible with its felt within another crucible; because, in such cases, asbestos felt is apt to curl at the edges, and without such precaution some of the precipitate might drop through the perforations and be lost. For drying at low temperatures, however, and even for ordinary ignitions, a second crucible is unnecessary; but, during the ignition of an easily reducible substance, care must be taken to prevent the contact of unburnt gas with the perforated bottom.

To perform the filtration, the crucible is replaced in the funnel, the pressure applied, and the process conducted precisely as in an ordinary filtration by the Bunsen pump. It is necessary to observe that the vacuum-pump is to be started before pouring the liquid upon the filter. The final drying or ignition, as the case may be, of precipitate and filter is made without difficulty, or need of extra precaution.

When turbid liquids are to be filtered, or gelatinous precipitates to be separated, instead of the perforated crucible, I prefer to use a platinum cone (Figs. 4 and 5), the upper part of foil (to make a tight joint with the rubber fitting of the funnel), the lower of gauze. The method of covering the gauze with felt is identical with that described above. By reason of the larger filtering surface of this apparatus, the tendency to become clogged is, of course, very much diminished. When subjected to

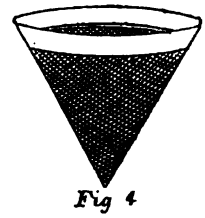


Fig 4

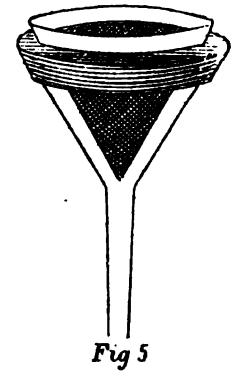


Fig 5

prolonged ignition, the gauze cone is enclosed within a crucible or a cone of platinum foil.

In operations in which platinum is liable to receive injury, a porcelain crucible, with a perforated bottom, may be used; but recourse to this is rarely necessary, particularly when one may use the gauze cone protected, as it is, by asbestos felt; moreover, the perforation of porcelain with numerous fine holes is a matter of considerable difficulty and expense.

Asbestos felt may be also used in the process of reverse filtering, it being merely necessary to dip the platinum rose into the asbestos mixture, after starting the vacuum-pump, in order to make the felt. The rose, with the felt attached, and the vessel in which the precipitate is collected, are to be weighed together, both before and after filtration.

Nothing can be simpler than the whole method of preparation and use of the apparatus which I have described, and its efficiency is extremely great. Clean water may, under the pressure of a Bunsen pump, be passed through a gauze cone coated with asbestos felt, which exposes a filtering surface of twenty-four square centimetres (nearly the same as that of a paper-filter, eight centimetres in diameter, when folded in the ordinary manner), with ease at the rate of a litre per minute.

When the filtering surface is less, the rapidity of filtration is, of course, somewhat diminished, but always exceeds that of paper of the same dimensions. When the felt is deposited upon gauze, the layer may be surprisingly thin and yet be efficient enough for all ordinary purposes. If the layer of felt be quite thick, the filtrate from baric sulphate freshly precipitated in the cold may be made to pass through clear. But the great superiority of asbestos felt lies in its constancy of weight, whether dried at high or low temperatures, the rapidity with which it may be safely and completely dried, and its refractoriness as regards acids (excepting hydrofluoric acid) and alkalies. These advantages appear most prominently in processes which involve the separation and desiccation:—

First, of precipitates which (like K_2PtCl_6, $[Hg_2]Cl_2$) must be dried at low temperatures, on account of a

tendency to decompose spontaneously at high temperatures;

Secondly, of precipitates which

(like Sb_2S_3,$PbSO_4$,$ZnCO_3$)

have usually been dried slowly and tediously at low temperatures, or have been separated from the filter before ignition, to avoid the danger of reduction by heating in contact with carbon;

Thirdly, of precipitates which

(like $(NH_4)_2MgP_2O_8$,$(NH_4)_2Mn_2P_2O_8$)

may be ignited in contact with carbon, but which make its complete combustion difficult.

In all cases, the time required to dry or ignite precipitate and filter is a minimum, inasmuch as heat may be applied as soon and to as high a degree as the precipitate itself will permit. Even in processes in which paper filters find their most convenient application, paper has generally no superiority over asbestos felt.

To illustrate the cohesiveness and refractory nature of the felt, I append the account of a single experiment. All of the liquids used had been previously filtered, excepting the distilled water with which the filter was washed, after the passage of each liquid. This precaution was considered unnecessary in the case of the water; but, if it had been taken, the slight *increase* of weight which was observed during the experiment would probably have been prevented.

Weight, in grammes, of crucible and felt, after ignition	20·2020
After second ignition	20·2020
After passing 100 cm³ of strong HCl through the filter *ten* times, washing and igniting	20·2020
After passing 100 cm³ of strong HNO_3 through the filter *ten* times, washing and igniting	20·2021
After passing 100 cm³ of strong H_2SO_4 through the filter *five* times, washing and igniting	20·2022
After passing 100 cm³ of a mixture of strong H_2SO_4 and water in equal parts, *ten* times through the filter, washing and igniting	20·2024
After passing 100 cm³ of water, containing in solution 50 grammes of NaOH *ten* times through the filter, washing and igniting	20·2028
Weight of crucible	20·1932
„ felt	0·0088

The whole process, involving, in all, the filtration of five litres of liquid (of which one litre was viscous), more than forty changes of the receiver, together with the ignition, cooling, and weighing of the crucible and felt seven times, was completed in two hours and ten minutes. The disc of felt was eleven millimetres in diameter.

ON SOME ANALYSES OF GLASS.

By SERGIUS KERN, M.E., St. Petersburg.

THE author expects that the following remarks on the analyses of an old water-gauge may be of some interest:—

About seven months ago the water-gauge was fitted to a boiler which was daily working. The glass of the gauge has now been found to be corroded to a great extent, and it is therefore replaced by a new one. The results of the analyses are the following:—

	Glass Tube.	
	Upper Part. Per cent.	Lower Part. Per cent.
Silica	72·65	72·62
Calcium oxide	9·94	9·96
Sodium oxide	15·10	15·42
Alumina + Ferric oxide	2·18	1·98
Sulphuric acid	0·01	traces
	99·88	99·98

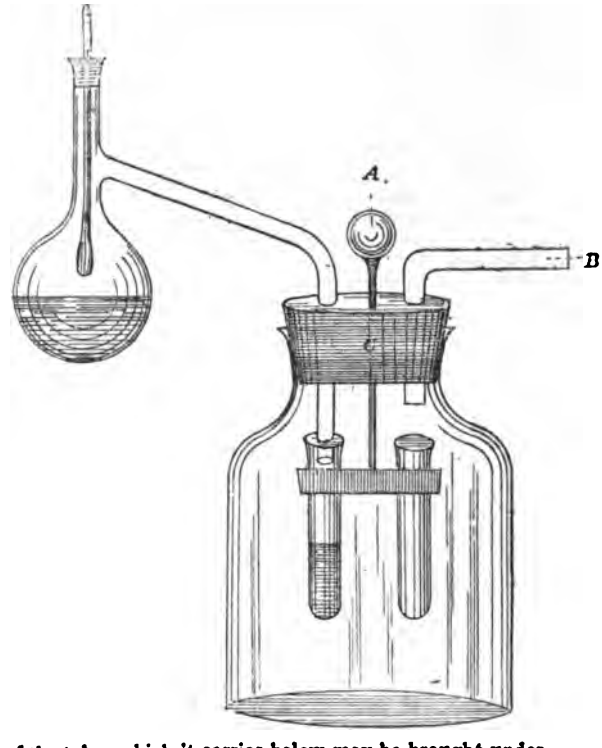
These analyses show the unfitness of a glass of such composition for most purposes. Such a glass cannot well stand the action of many reagents, or even that of water. Indeed, there is an excess of alkali and a rather small quantity of calcium oxide. The percentage of silica is nearly the normal amount. In order to prevent accidents, water-gauges carefully prepared and of the best quality ought only to be used.

Obouchoff Steel Works.

NEW FORM OF APPARATUS FOR FRACTIONAL DISTILLATION UNDER DIMINISHED PRESSURE.

By E. J. BEVAN.

THE figure needs no explanation beyond stating that by means of the rod A moving, air tight, in the cork C, any



of the tubes which it carries below may be brought under the delivery tube of the fractionating flask. The apparatus is connected at B with an exhausting pump.

Owens College,
March 25.

Action of Ozone upon Iodine.—J. Ogier.—If the effluve is caused to act upon a mixture of oxygen and iodine in a large effluve-tube, heated in the acidulated liquid which serves as an electrode so as to keep the iodine in a state of vapour, the different oxygen compounds of iodine are rapidly formed in different parts of the tube. At the lower part, where the iodine is in excess, there is a deposit of iodous acid, more or less mixed with iodine. Above is a lemon-yellow layer of hypoiodic acid. At the upper part towards the extremity of the annular space where the effluve is produced iodic acid accumulates, whilst the annular space itself is lined with a thin white layer of periodic acid.—*Comptes Rendus*, lxxxvi., No. 11.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 11, March 18, 1878.

Researches on the Absorption of the Ultra-Violet Rays by Various Substances.—J. J. Soret.—Spectral analysis by absorption has been hitherto almost exclusively limited to the visible rays, and important results will doubtless be obtained by extending it to the ultra-violet rays. The use of the spectroscope with a fluorescent eye-piece greatly facilitates this class of observations, and renders it possible to operate upon the ultra-violet spectrum in its full extent with almost as much ease as upon the luminous spectrum. It is sufficient to be provided with an instrument fitted with quartz lenses and prisms and a good induction apparatus in order to study as regards absorption the numerous bodies, which are colourless in the ordinary sense of the word, but the bulk of which are chroic, that is to say, intercept a part of the invisible rays. The author has undertaken in this direction a series of researches, employing as a source of light the induction sparks obtained between various metals, such as cadmium, zinc, aluminium, and iron. The rays were concentrated upon the slit of the spectroscope by a lens of quartz with a short focus. Among the substances experimented upon are quartz, Iceland spar, distilled water, sea-water, nitric acid, &c. A large number of substances at certain degrees of dilution give rise to absorption-bands in the ultra-violet spectrum, such as the alkaline chromates and bichromates (250 m.grm. neutral chromate of potassa to the litre) which present two absorption-bands, nitrate of potassa, sulphates of didymium and cæsium, permanganate, the aqueous solution of sulphurous acid, which display one absorption-band. Commercial caustic ammonia, and the sulphates and hydrochorates prepared with this product, also show an absorption-band, due, however, to a foreign substance not easily eliminated.

On a New Telephone, the so-called "Mercurial."—A. Breguet.—This instrument cannot be intelligibly described without the accompanying illustration.

Detection of Plumbic Oxide in Pharmaceutical Bismuth Sub-nitrate.—A. Carnot.—The author takes from 10 to 20 grms. sub-nitrate and treats it with strong hydrochloric acid in a porcelain capsule. The solution s concentrated to a syrup, slightly acidified so as to render it perfectly fluid, a few drops of sulphuric acid are added, and 30 to 40 c.c. of alcohol. If the alcohol is too weak a white turbidity appears in the liquid, which may be got rid of by the addition of a little hydrochloric acid. It is let stand for a day, decanted over a small filter, washed by decantation with alcohol, acidified with two or three drops of hydrochloric acid, the precipitate received on the filter, and the washing is completed with pure alcohol. When dry the filter is separated, burnt by itself, the ashes added to the residue in a very small balanced porcelain capsule, moistened with sulphuric acid, evaporated, and heated to redness, and the residue weighed as lead sulphate.

Researches on Gallium.—A. Dupré.—M. Lecoq de Boisbaudran placed at the author's disposal 2 grms. of this metal. At 260° pure dry oxygen exerted no sensible action upon the metal, but at incipient redness it loses its brilliance, and is covered with a very thin pellicle of a greyish blue colour :at a full red heat the layer of oxide becomes more distinct, but it protects the metal from further oxidation. At bright redness a slight sublimate of oxide was formed in the hottest parts of the tube. The simplest way of obtaining the oxide is the decomposition of the nitrate. The gallium is treated with monohydrated acid free from nitrous vapours; in the cold the action is almost *nil*, but at 40° to 50° it begins and is continued regularly with the formation of a grey deposit very slow to dissolve. The nitric solution, after being deprived of a part of its acid over the open fire, was heated in a stove to 110°, when a commencement of decomposition was manifested. The salt, partly decomposed, was then taken up in water, evaporated to a syrup in the water-bath, and placed whilst cooling in an exsiccator. The nitrate then forms a white compact mass, very deliquescent, and giving off an odour of nitric acid, which, as well as the moisture, may be removed in a dry vacuum, or in a current of dry air at 40°. The dry nitrate, heated to 200° in a current of dry air, loses 63·8 per cent of its weight. This loss, representing nitric acid, renders it probable that the salt is a nitrate of the sesquioxide. When this salt is decomposed by heat the sesquioxide remains as a white, fritted, very friable mass, which, if heated in a current of pure dry hydrogen, sublimes in part and suffers reduction to some extent. At a cherry-red heat the action of hydrogen gave a bluish grey substance resembling the pellicle formed on the oxidation of gallium. Notwithstanding its blue tint the oxide does not seem to contain appreciable traces of metal, for on treatment with nitric acid there is no evolution of nitrous vapours. It dissolves also in dilute sulphuric acid without escape of gas, and the solution reduces permanganate. This greyish blue matter seems to be a lower oxide of gallium, probably the protoxide, for the sulphuric solution of the sesquioxide does not reduce permanganate. Sulphate of sesquioxide mixed with ammonium sulphate and set aside yields crystals of gallic alum, whilst the salt which appears to be sulphate of protoxide produces nothing similar.

No. 12, March 25, 1878.

Effects of the Rheostatic Machine.—G. Planté.—The effects produced by this apparatus much resemble those obtained with electric machines and induction coils, but present at the same time certain distinctions. The difference between the characters of the electricity emanating from the two poles is perhaps more marked. The light produced in a vacuum is brighter than that of electric machines, and when the rotatory movement is rapid it is as bright and continuous as that of induction-coils.

Hydrate of Ether.—C. Tanret.—This compound, $C_8H_{10}O_2+2H_2O_2$, is formed in the shape of a hoar-frost, and resembles the substances to which Mr. Guthrie has given the name of cryohydrates.

Constitution of Wool and of Certain Similar Products.—P. Schutzenberger.—Wool heated to 150° to 180° with water and three or four parts of hydrate of baryta behaves like the albuminoids yielding ammonia, acetic, carbonic, and oxalic acids, and various amidic compounds, among which caproic leucin, tryosin, butyric and valeric leucin, propionic leucin, and glucoprotein.

Justus Liebig's Annalen der Chemie, Band 191, Heft 1 and 2.

Communications from the Chemical Laboratory of the University of Greifswald.—These consist of papers by H. Limpricht on "Bromised Sulphobenzolic Acids; by Dr. A. Langfurth, on the "Bromine Derivatives of Metamido-sulpho-benzolic Acid;" and by Dr. R. Bässmann, on the "Sulpho-acids of Symmetric Tribrom-benzol and its Derivatives."

Les Mondes, Revue Hebdomadaire des Sciences, No. 11, March 14, 1878.

This issue contains no original chemical matter.

No. 12, March, 21, 1878.

Ultramarine, with the further addition of sulphate of

tin and alum, is said to be used for improving the colour of certain kinds of powdered sugar.

The lees of wine are now employed as a source of tartaric acid.

MISCELLANEOUS.

Serious Accident to Mr. William Baker, of Sheffield.—On Monday evening last Mr. W. Baker spent a few hours at the Sheffield Club, of which he is a member, and about 11 o'clock he prepared to go home. He had been in the billiard room, which is at the very top of the building. During the evening he had been performing a number of athletic feats, and when he left the billiard room, instead of descending the stairs in the ordinary manner, he attempted to slide down the banisters. He had only gone a very short distance when he lost his balance and fell over. He pitched upon the banisters of the next flight, and from them to the next banisters, and finally dashed head foremost upon the tiled floor of the hall. His skull was terribly fractured, and a portion of his brain protruded. He was taken into one of the club-rooms, where he remained during the night, and on Wednesday morning he was removed to his residence. Not the slightest hopes are entertained of his recovery.

Russian Scientific News.—Prof. Lesgaft has delivered an interesting lecture before the Technical Society on the *modus operandi* of baking biscuits and the preparation of conserves. The experiments of the lecturer proved that in order to support the human organism in good health the proportion between the nitrogen and carbon of the food must be as 1 : 4·5, so that 750 grms. of solid food are quite sufficient for daily nourishment. This quantity, according to his experiments, must contain—

Albuminous matters	150 grms.
Fat	100 ,,
Hydrocarbons	475 ,,
Various salts..	25 ,,

Prof. Lesgaft believes that a man at work requires not less than 600 grms. of meat.

M. Pallizen presented to the Imperial Academy of Sciences a very rare specimen of a complete skull of the semi-fossil animal, *Elasmotherium*, the nearest relative of our rhinoceros. The skull was found in the alluvial sands of the River Volga, near Sarepta, and is more than 3 feet in length.

M. Petrouchevsky has made some experiments with the Jablochkoff electric candle. He measured the intensity of the light given by them. Two specimens of candles were used for this purpose :—(1) Candles in which the carbons were divided by gypsum; (2) candles with carbons divided by kaolin. Bunsen's photometer was used. The following are the results :—

(1.) *Candles with Gypsum.*

Intensity of Light. (In Stearine Candles.)	Quantity of Revolutions per Minute of Machine.
931	1200
931	1350
1495	2500

(2.) *Candles with Kaolin.*

414	1224
402	1200
517	1222

These experiments show that it is better to divide the carbons of the candles by gypsum; but it was also remarked that the light produced by candles with kaolin has more steadiness and is more agreeable. During these experiments one of Gramme's small magneto-electric machines was in use.

Prof. E. Schöne, of Moscow, has published two books containing numerous and valuable experiments on hydrogen peroxide, and on the occurrence of ozone and hydrogen peroxide in the atmosphere. Prof. Schöne comes to the following conclusions :—Sunlight accelerates the decomposition of hydrogen peroxide in aqueous solutions; this compound is not an electrolyte. The reaction which takes place between ozone and hydrogen peroxide in the presence of water is the following :—

$$H_2O_2 + O_3 = H_2O + 2O_2.$$

The presence of ozone in the atmosphere cannot be strictly detected by Houzeau's or Schonbein's ozonometrical papers; also the presence of ozone in the atmosphere is not ascertained, but hydrogen peroxide was found to be one of the normal constituents of the atmosphere. Experiments proved that in summer time the atmosphere contains a higher percentage of hydrogen peroxide than during the winter. The higher from the surface of the earth commences the condensation of the clouds the greater is the percentage of hydrogen peroxide in the air. Hydrogen peroxide combines readily with the peroxides of barium, sodium, and potassium, and yields compounds of the following composition :—

$$BaH_2O_4, Na_2H_4O_6, K_2H_4O_6.$$

During Schöne's experiments, all the year round, he found that 1 square metre of earth absorbs 110 milligrms. of hydrogen peroxide—a very small quantity indeed; but when we remember that very small quantities of ammonia and nitric acid have an influence on vegetable life, we may also suppose that the hydrogen peroxide of the air also plays a necessary part in nature's economy.

S. KERN, M.E.

St. Petersburg.

NOTES AND QUERIES.

Oil for Leather.—Can anyone inform me of a good method whereby I can readily determine the quality of oil; I may add that in my business cod oil is used to a large extent for what is termed 'buff leather."—T. P.

MEETINGS FOR THE WEEK.

MONDAY, May 6th.—Medical, 8.30.
— Royal Institution, 2. General Monthly Meeting.
— Society of Arts, 8, (Cantor Lectures). "Some Researches on Putrefactive Changes, and their Results in relation to the Preservation of Animal Substances," Dr. B. W. Richardson.
TUESDAY 7th.—Civil Engineers, 8.
— Zoological, 8.30.
— Photographic, 8.
— Royal Institution, 3. "On Some Points in Vegetable Morphology," W. T. Thiselton Dyer, M.A.
WEDNESDAY, 8th.—Society of Arts, 8. "The Phonograph, or Talking Machine," Mr. W. H. Preece.
— Geological, 8
THURSDAY, 9th.—Royal 8.30.
— Royal Institution, 3. "On Colour," Lord Rayleigh, M.A.
— Society of Arts, 8. (Chemical Section). "Some Recent Improvements connected with Alkali Manufacture," James Mactear.
— Mathematical, 8.
FRIDAY 10th.—Royal Institution, 8, Weekly Meeeting. At 9, "Effects of Stress on Magnetisation of Iron, Nickel, and Cobalt," Sir William Thomson.
— Astronomical, 8.
— Quekett Club.
SATURDAY, 11th.—Royal Institution, 3. "On Richard Steele," Prof. Henry Morley.
— Physical, 3.

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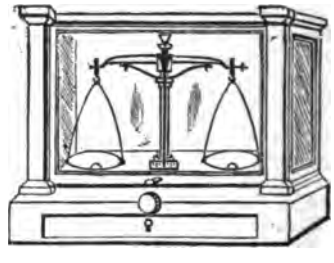

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 963.

PARAFFINS IN COMMERCIAL "WATER-GAS."

By HENRY MORTON, Ph.D., and WM. E. GEYER, B.S.

SOME experiments made by us with a "water-gas," as it is here technically called (*i.e.*, a gas made by mingling the products of the reaction of steam and carbon with oil-gas, or like products of the decomposition of petroleum or naphtha), led to the conclusion that this material contained some members of the marsh-gas or paraffin series, richer in carbon than marsh-gas itself. Such paraffins would, of course, play the part in such a gaseous mixture of practical illuminants, but not being absorbable by Nordhausen acid, would not be determined with the "illuminants" technically so called, in the usual process of gas analysis, and would be left to influence the results of those subsequent steps of the process which only contemplate the presence of free hydrogen and marsh-gas.

In looking about for suggestions as to the proper treatment of such a mixture, in order to make an analysis of the same, we found that little had been accomplished, and that that little was in some cases mixed with serious error.*

Even where the true conditions of the problem in certain cases are recognised, as in Bunsen's "Gasometrische Methoden," 1877, p. 249, and in Sutton's "Volumetric Analysis," 1871, p. 338, the case is not presented with the full generality of which it admits, and we have, therefore, thought it worth while to work out, and present a general discussion of the problem presented by the presence of a mixture of hydrogen, marsh-gas, and higher members of the marsh-gas series, in relation to the usual methods of eudiometric analysis.

In the first place the question presents itself—Can such a mixture be determined by any of the usual eudiometric methods?

Sutton and Bunsen state that a mixture of hydrogen and ethane may give exactly the same results as an equal volume of marsh-gas; but we may ask how extended is this possible ambiguity? Does it extend to any mixture of members of the marsh-gas series? Can even free hydrogen, as Fouqué supposes, be determined in presence of such a mixture?

To facilitate this discussion, we will, in the first place, present a table of the volumes of carbonic acid formed, of contraction produced, of oxygen consumed, and of water vapour developed by the explosion in the usual manner of several members of the marsh-gas or paraffin series.

For reasons which will presently appear, we include hydrogen in this table as the first of the series.

	H.	CH_4.	C_2H_6.	C_3H_8.	C_4H_{10}.	C_5H_{12}.
CO_2 formed ..	0	1	2	3	4	5
Contraction ..	$\frac{1}{2}$	2	$\frac{7}{2}$	3	$\frac{13}{2}$	4
O consumed ..	$\frac{1}{2}$	2	$\frac{7}{2}$	5	$\frac{13}{2}$	8
H_2O formed ..	1	2	3	4	5	6

It will be noticed that in this table—

The CO_2 formed increases regularly by 1 from 0 upwards.
The contraction ,, ,, $\frac{1}{2}$,, $\frac{3}{2}$,,
The O consumed ,, ,, $\frac{3}{2}$,, 1 ,,
The water formed ,, ,, 1 ,, 1 ,,

* See "Etude Chimique des cinq gaz des sources de pétrole de l'Amérique du Nord." Note de M. F. Fouqué. *Comptes Rendus*, Nov. 23, 1868, vol. 67, p. 1045. Also "Comp. of Natural Gas from Certain Wells in Western Virginia," by S. P. Sadtler. *Proc. Am. Phil. Soc.*, vol. xvi., pp. 2065 and 586.

The CO_2 formed by 1 volume of hydrogen, the first member of this series, is $0=1-1$; by the second member it is $1=2-1$; by the third it is $2=3-1$. By any other members represented by l, m, n, it will be $l-1$, $m-1$, and $n-1$, and so on.

The contractions produced by the various members will likewise be as follows:—

1st member $\frac{1}{2}=\frac{3+1-1}{2}$

2nd ,, $2=\frac{3+2-1}{2}$

3rd ,, $\frac{3}{2}=\frac{3+3-1}{2}$

lth ,, $\frac{3+l-1}{2}$

mth ,, $\frac{3+m-1}{2}$

nth ,, $\frac{3+n-1}{2}$

The oxygen consumed will be, for the

1st member $\frac{1+3(1-1)}{2}$

2nd ,, $\frac{1+3(2-1)}{2}$

3rd ,, $\frac{1+3(3-1)}{2}$

lth ,, $\frac{1+3(l-1)}{2}$

The water formed will be, for the

1st member 1
2nd ,, 2
3rd ,, 3
lth ,, l.

If then we express by x, y, z, &c., the respective volumes of any number of such constituents in a mixture of gases and vapours in which they occur, they being respectively the lth, mth, nth, &c., orders of the series CnH_{2n+2}, and indicate by V the total volume of the mixture, by C the volume of carbonic acid formed, and by A the contraction after explosion, by O the oxygen consumed, and by W the water vapour formed, we shall have—

$$x+y+z+\ldots\ldots\ldots\ldots\ldots=V \quad (1)$$

$$(l-1)x+(m-1)y+(n-1)z+\ldots\ldots\ldots=C \quad (2)$$

$$\left(\frac{3+l-1}{2}\right)x+\left(\frac{3+m-1}{2}\right)y+\left(\frac{3+m-1}{2}\right)z+\ldots=A \quad (3)$$

$$\frac{1+3(l-1)}{2}x+\frac{1+3(m-1)}{2}y+\frac{1+3(n-1)}{2}z+\ldots=O \quad (4)$$

$$lx+my+nz+\ldots=W \quad (5)$$

From equations (2) and (3) we obtain by clearing (3) of fractions—

$$(3+l-1)x+(3+m-1)y+(3+n-1)z+\ldots=2A,$$

subtracting (2) and dividing by 3 we get—

$$x+y+z+\ldots=\frac{2A-C}{3}, \quad (6)$$

an equation identical with (1), and therefore showing that the results are indeterminate.

If we resort to equations (4) and (5) the results are in all respects as unsatisfactory as with equation (3). Thus from twice equation (4) subtract three times equation (2)

$$[1+3(l-1)]x+[1+3(m-1)]y+[1+3(n-1)]z=2O$$
$$3(l-1)x+\quad 3(m-1)y+\quad 3(n-1)z=3C$$
$$x+\quad y+\quad z=2O-3C \quad (7$$

Equation (7) like equation (6) is identical with (1).
Again, from (5) subtract (2). We have—

$$\begin{array}{rl} lx+ \quad my+ \quad nz+ \ \ldots\ & =W \\ (l-1)x+(m-1)y+(n-1)z+ \ \ldots\ & =C \\ \hline x+ \quad y+ \quad z+ \ \ldots\ & =W-C \end{array} \quad (8)$$

which is also identical with equation (1).

From all this it follows, that in the case of any one of these gases, or in the case of any mixture of any number of them, the following relations will hold—

$$V=\frac{2A-C}{3}=2O-3C=W-C=\frac{3W-2O}{2}=\frac{2A-W}{2}.$$

The above considerations have acquired a certain amount of practical importance from the presence of these paraffins, as above mentioned in the commercial products, known as "water-gas," which are now being manufactured on a large scale in several places, and which have thus come under the hands of chemists for examination and analysis.

As a preliminary method for obtaining at least an approximate determination, we had resort to the absorption of these substances in absolute alcohol, as noted by Sutton, "Vol. Anal." p. 323, and in Watts's "Dict. of Chem." vol. i., p. 286.

In place, however, of allowing for the added tension of the alcohol vapour, we removed it by absorption with Nordhausen acid. We also made allowance for the solution of hydrogen, marsh-gas, and carbonic oxide in the alcohol employed.

By these means we obtained such results as the following.

"Water-gas" made by the Municipal Company of New York,* working under the Tessié du Motay patents :—

Carbonic acid	18·050†
Oxygen	
Olefines	
Carbonic oxide	26·790
Marsh-gas	21·646
Hydrogen	27·897
Nitrogen	4·243
Paraffins	0·702
	99·328

An analysis of the same gas made in the usual way gave the following result :—

Carbonic acid	0·327
Oxygen	0·561
Olefines ("illuminants")	16·323
Carbonic oxide	27·337
Marsh-gas	25·985
Hydrogen	24·889
Nitrogen	4·572
	99·994

The difference between these analyses in the values assigned to hydrogen and marsh-gas are (other errors excepted) due to the presence of the 0·7 per cent of "paraffins."

If we assume the average composition of these paraffins to approach that of propane, this would just about account for the discrepancy.

When the gas was passed for an hour in a slow stream through a quantity of absolute alcohol, this yielded on boiling about 30 per cent of gas not absorbable by bromine, chloride of copper, pyrogallic acid, or caustic potash, and which, when treated with absolute alcohol was, in part, absorbed in a very high ratio, the first dose of alcohol dissolving about six times its volume. The alcohol from which this gas had been driven off by boiling, on dilution with water, became cloudy, and on standing threw up an oily layer, which had an odour resembling that of allylene and crotonylene.

It thus appears evident that members of the paraffin series, pretty high in the scale, were present, and that the supposition that their average composition was about that of propane is highly probable.

The treatment with alcohol and subsequent manipulation and calculations require much time, and of course only yield approximate results, but they at least show, what is of considerable practical importance, that the amount of these paraffins is small, and that the ordinary methods do not involve errors practically important under the existing conditions.

Another variety of water-gas, made at Harrisburg, Pa., under the Lowe patent, gave the following results under the two methods of treatment :—

	Usual method.	With alcohol.
Carbonic acid	3·403	3·402
Oxygen	0·340	Trace
Olefines	11·782	12·828
Carbonic oxide	27·216	25·233
Marsh-gas	21·740	21·699
Hydrogen	32·567	34·548
Nitrogen	2·945	1·408
Paraffins	Not estd.	0·869
	99·993	99·987

The specimens here examined, though collected on the same occasion, do not appear to be actually identical. In fact, the holder used at these works is so small that it has to be re-filled several times in the 24 hours. This is probably the reason for the less complete accordance with theory observed in these two analyses, if assumed to be made from an identical mixture.

ON DYER'S CHEMICALS.

By J. MARZELL.

(Continued from p. 146.)

NAPHTHALIN, $C_{10}H_8$.

RESPECTING the quantity of naphthalin yielded by coal-tar there is very little to say, as the few notes relating to it generally refer only to certain tars, got at certain times and according to certain methods, and therefore of very limited or no use for us. Some definite results, however, are shown by Crace-Calvert's careful researches, who puts up the following numbers :—

Cannel coal yields about .. .. 15 per cent naphthalin.
Newcastle coal yields about .. 58 ,, ,,
Staffordshire coal yields about.. 22 ,, ,,

Contrary to the conditions of formation of benzol, the tar is the richer in naphthalin the higher the temperatures used in the gas-works, which is easy to understand in looking at the circumstances of its formation. Already, in 1858, H. Schwarz* gave the opinion that the naphthalin might be a product of decomposition of benzol, as follows :—

$$\underbrace{2C_6H_6}_{\text{Benzol.}} = \underbrace{C_{10}H_8}_{\text{Naphthalin.}} + \underbrace{C_2H_4}_{\substack{\text{Ethylen.} \\ \text{(Light Gas.)}}}.$$

* It may be of interest to note that the details of the process here mentioned are as follows :—Superheated steam is passed, for about ten minutes, into a "gasogen," or cupola furnace, previously brought to a state of intense ignition by a blast of air; and the mixture of hydrogen, carbonic oxide, and a little carbonic acid, &c., generated, is cooled, purified by lime, and stored in a small gas holder.

When the steam jet has cooled the cupola beyond the proper point, it is shut off, and the air blast renewed for about an equal time, during which the products of combustion escape into the air; the steam is then again turned on, and so the processes are alternated.

From the small holder the gas passes through a set of carburetters, where naphtha is continuously run over iron shelves in face of the flowing gas, and the whole apparatus is maintained at a constant temperature by a steam jacket. The gas thus saturated with naphtha-vapour, is then run through retorts, kept at a very high temperature, where it is fixed, *i.e.*, where the naphtha-vapour is split up into "olefines" (technically so-called), marsh-gas, and hydrogen. It then passes into the storage-holders and is ready for distribution.

† The proportions of these several constituents not being in question, they were not separately determined to save time.

* *Dingler's Journal*, cxlvii., 229.

And ten years afterwards the brilliant synthetical works of Berthelot rendered it certain that the naphthalin is simply a derivative of benzol.

$$\underbrace{C_6H_6}_{\text{Benzol.}} + \underbrace{C_2H_4}_{\text{Ethylen.}} = \underbrace{C_8H_8}_{\text{Styrol.}} + \underbrace{2H.}_{\text{Hydrogen.}}$$

$$C_8H_8 + C_2H_4 = \underbrace{C_{10}H_8}_{\text{Naphthalin.}} + 4H.$$

$$C_6H_6 + \underbrace{2C_2H_2}_{\text{Acetylen.}} = C_{10}H_8 + 2H.$$

$$C_8H_8 + C_2H_2 = C_{10}H_8 + 2H.$$

*The Manufacturing Process.**

The methods indicated by Laurent are merely of historical interest in the present state of tar distilling. A method still in use in many of its points is the following:—That part of the coal-tar solidifying in the cold on account of its containing naphthalin is allowed to stand for six or eight days. The fluid part is then taken off, the crystals smashed to a paste, from which the oil is taken out by means of a centrifugal machine, and finally by hydraulic pressure. The resulting residue of crude naphthalin is melted and mixed with some per cents of caustic soda lye. The tanks used for that are made of iron, and provided either with a steam-jacket, or, better, with a system of steam pipes lying on the bottom. The naphthalin is put in, melted, and then the caustic soda is added with well stirring. It is advisable to wash two or three times with soda, taking off the top-liquor each time. After that, washings with hot water have to be continued to entire neutralisation or till red litmus-paper is no longer coloured blue. By the alkaline soda the tar-acids are removed.

The so-far purified liquid naphthalin is well mixed with some per cents of sulphuric acid (brown will do, but it is better to use acid of 1·840 sp. gr.) the supernatant acid liquor is taken off, and the remaining naphthalin is washed till it is quite neutral. Afterwards a quantity of a strong caustic soda-lye is added, well mixed, and the whole allowed to stand quietly for two or three hours at 100° C.

The naphthalin whilst fluid is let into stills, and driven over by means of open fires. The stills are either of wrought- or cast-iron; those containing 200 to 250 gallons have yielded good results. At the beginning, the distillate is mixed with small quantities of water; but at about 210° C. a continual stream of naphthalin comes over, and that so quickly that in twenty minutes 1 cwt. of naphthalin can be easily obtained. Great care has to be taken in keeping the water in the condenser always at 80° C., as otherwise, by solidifying, the naphthalin would stop up the coil. The receiver is of iron, with a cover, and provided with a man-hole, and stands in a steam-bath, which allows a temperature of about 80° C. to be maintained, and the naphthalin to be kept in a liquid state. Hence the pure naphthalin is run into moulds of glass, iron, or wood (the latter has to be moistened first), and allowed to solidify. Usually it is cast in the form of bricks.

As soon as the temperature in the still has risen to 230° to 235° C. the distillate becomes yellow, and is mixed with many oily impurities. As soon as that occurs the receiver has to be changed, and the now coming over distillate is added to another charge for re-distilling.

The naphthalin resulting from this method is in the form of a mass of white crystals showing a spiral structure.

A method offering much advantage is the extraction of the naphthalin from the last parts of the "light oils." Respecting the working-up of the "light oils," it may be remembered that after the extraction of carbolic acid and its homologues by treating with caustic soda solution the oils are submitted to re-distillation. That part going over till about 200° C. (called "crude naphtha," showing a specific gravity of 0·93 = 10° under proof = 13 to 14° Tw.) is put to the "first runnings" to be washed and re-distilled with them, whilst everything passing between that point and a specific gravity below 1·00 (till a sample thrown into water sinks down) is put to the next lot of "light oils" for refining. The remaining residue, varying between 25 to 50 per cent of the whole charge, is usually put to the "creosote oils." But if instead of that the distillation is pushed forward, the distillate soon solidifies in the receiver to a white paste of naphthalin crystals. On submitting this product to hydraulic pressure naphthalin is obtained quite pure and white. If it retains traces of oils it gets red in contact with the air, and therefore the pressure has to be carried through with great attention. In case the utmost purity is wanted, by washing with alcohol the last impurities can be taken away, the spirit being easy to separate from the higher boiling oils. In this method advantage is taken of the treating with caustic soda for the purpose of taking out the tar-acids. It acts in a similar way as in the method already described of washing with soda.

To examine a product of distillation for naphthalin, the substance is treated with fuming nitric acid, the resulting nitro product is washed with water to perfect neutrality, and then put into a boiling mixture of 1 part of K_2S to 1 part of KOH (caustic potash). In case naphthalin is present, a splendid violet-blue colour will be observed.

For purifying sufficiently for the purpose of bringing the naphthalin into a form in which it can easily be attacked by any reagents, sublimation is used with great advantage.

An impure red naphthalin can be got in white leaflets if it is mixed with quartz-sand and submitted to a slow sublimation on the water-bath. The quartz acts as a filter in this way, keeping back the higher boiling impurities.

The naphthalin fusing at 79° C. sublimes very easily, and without any great loss by carbonisation, &c. The most simple way, and one which can be used with great advantage for the production of limited quantities of naphthalin is the following:—The apparatus consists of a cast-iron pot of about 4 ins. internal diameter by 3 ins. internal diameter, set in brick-work, having a fireplace beneath, but with an arrangement that the flame cannot play directly on the vessel. As receiver, a common cask of about 5 feet in height by 4 feet internal diameter can be taken, which is put over the opening of the iron pot, and rests on the stone plate covering the hearth. At the upper end a small hole allows the non-condensed vapours to escape. It is useful to provide the cask with a lifting-screw, so that after the operation is finished, the receiver with the sublimate can be moved about without shaking. The pot is filled, the fire lighted, and then the cask put on. The rising vapours are condensed into the receiver, and settle into a thick crust of white naphthalin on the walls. Great attention has to be paid to the fire, and it is a point of importance always to keep the lowest temperature possible. It is clear that at a higher heat the receiver itself gets warm and cannot act as condenser, and the consequence will be that the naphthalin vapours will melt and run back into the pot.

The inconvenience of working with the small cask, if the produce is large, soon led to the improvement of subliming chambers. They represent large rooms built of bricks, the walls often lined with wood on account of cleanliness. In the ceiling there is usually a small tower-like addition, shut loosely by a wooden flap-valve, which in case of an explosion, or even pressure inside the chamber, can easily be thrown open by the vapours or gases, thus allowing a way of escape. At the side opposite the inlet-pipe there is a wooden door by which the chamber can be emptied after the operation is over. The subliming-pot is of the same shape as before, but shut by means of a cover, which is fastened by screws, and provided with a man-hole. A 3 inch pipe effects the communication with the chamber. The retort is often lined with Chamotte to prevent destroying and coking by direct

* Vohl, *Dingler's Journal*, clxxxvi., 138; Lunge, Theer Distillation, Braunschweig, 1869.

contact with the hot iron: sometimes an oil-bath is preferred for the same reason. It is needless to say that here also the temperature has to be kept at the lowest point possible, to prevent a distillation taking place instead of a sublimation. The vapours enter the chamber, and are condensed at the cold walls and at the bottom. The operation being finished—that is to say, the number of pots calculated for one charge of the chamber being driven over—the door of the chamber is opened, and the sublimate scraped out. The utmost attention has to be paid to the rule never to open the man-hole of the pot and the door of the chamber at the same time, as by the resulting air-currents an explosion of the hydrocarbon vapours may take place very easily, although, of course, not to the same extent as with bodies fusing and subliming at a higher temperature than naphthalin. But as the subliming apparatus in most cases is used for other hydrocarbons (*e.g.*, anthracen, phthalic acid, &c.), it is advisable to fix the rule above mentioned for every operation with the sublimer.

To quicken the operation, or to withdraw the rising vapours immediately from the pot, two methods are adopted—(1) To draw them out by means of a ventilator; or (2) to blow them out by superheated air or steam.

In the first case centrifugal ventilators, acting as suckers, are used (generally a paddle-wheel, the three-bladed wheel of Tabry's or the silent fan of Schiele, which perfectly answer the purpose), The ventilator is of wood, and although the diameter is easily found out by mechanical calculation, the velocity of rotation has to be found out by experience and practice. Another action of the ventilator is the creating and maintaining of a vacuum, owing to which the naphthalin, submitted to a lower pressure of air, sublimes more easily and at a lower temperature. The ventilator is put up inside the chamber fronting the end of the inlet-pipe. To fix it in the pipe itself would not be practical, as it would cause stopping, &c.

As to the blowing out of the vapours by means of superheated steam or air, this method is usually employed. In using air precaution has to be taken first to free it from oxygen. The operation well conducted, so that the heat is not too high,– scarcely more than 100° C. are wanted—and the condensation proceeding well no pressure or superheating of the vapours is caused. There is no fear of oxidation with the oxygen, but it is better to provide for all contingencies, and not to risk the apparatus and all by a wrong economy. For the blowing in of air, ventilators of the most simple construction generally answer the purpose. A certain pressure is necessary, but an excess would only interfere by blowing out the melted and non-melted contents of the retort. Practice will very soon teach the right point. Between the ventilator and the retort a system of iron pipes is interpolated, laying in an oven, and filled with charcoal. By making them red-hot, and forcing the air through, all the oxygen will be burnt to CO and CO_2, and thus made harmless. It is not to be forgotten that by the expansion caused by the superheating the pressure of air rises considerably. The iron pipes in the superheater have to be made thick and strong, as by a crack the pressure of air, finding another outlet, would be weakened a good deal. The conducting-pipe from the deoxidiser to the pot is of about ½ inch, and ends below the surface of the cover just inside the pot. To bring it right into the stuff itself and so effecting a stirring at the same time is not advisable, as a continual nuisance by stopping, &c., would arise. Besides the outlet-pipe, there is another short pipe of about ¾ inch, provided with a cock. It serves to examine from time to time the inside of the pot, whether the stuff is melted and whether it is blown out, whether there is pressure enough on, too much, or too little, &c. The pot is charged through the man-hole, the fire put on, and as soon as the naphthalin is fused the air admitted.

If instead of air steam is used, the deoxidiser is changed to a superheater, the steam being supplied from the next steam-boiler. The pipes are stronger than those used before, and have to be calculated for standing a high pressure. In the chamber an arrangement is made to precipitate the entering naphthalin vapours by a fine shower of cold water, and in this case the bottom is changed into a filter. The filter-cloth can be of any material (linen, wool, or cotton), as the naphthalin is usually quite neutral or only very slightly acid, if the purifying (washing) process has not been carried out carefully. This arrangement allows the taking of chambers of far smaller dimensions than would be necessary with the methods above described, where the vapours have to condense themselves. The naphthalin taken out of the filter-chamber in the form of a white loose mass of leaflets has to be brought into drying-rooms heated by steam. It would seem practical to submit the naphthalin at first to a hydraulic pressure; but in most cases that cannot be done, as instead of a loose sublimate the naphthalin is got in lumps, which even by a very careful powdering does not assume the advantages of a sublimate.

As to the pot used in both cases—working with air or steam—it is commonly, as above described, lining the inside with Chamotte, immersing the pot in an oil-bath, and other precautions against injury, &c., vary with nearly every works. Instead of putting the stuff into a pot deeper than wide, with great advantage flat apparatus have been introduced. They are set in an oil-bath, and the stuff is spread in thin layers over a kind of hurdle inside the pot, so as to offer a great surface, and not being in direct contact with the walls. The steam is introduced either from above or from the bottom, blowing upright in the latter case. Sometimes a combined action of ventilator and injector is found useful.

For a mere sublimation of naphthalin nobody, of course, would put up so complicated a plant as the last ones described; but as in most cases the sublimer is used for other materials as well, I thought it might perhaps be of some interest to many of the readers of the CHEMICAL NEWS to have a description, even only in a few words, of the subliming apparatus as used in chemical works with good results.

(To be continued)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 2, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

After confirmation of the minutes, &c., the names of the following candidates were read for the first time; E. R. Budden, A. A. Drinkwater, and J. Collins.

The PRESIDENT then called on Mr. SIDNEY H. VINES to deliver his lecture "*On the Chemical Aspects of Vegetable Physiology.*" The investigation of substances which occur in the cells of plants has for a long time formed a favourite theme for chemists, whilst the decomposition of these substances has added largely to our knowledge of chemistry. It is strange that but few researches have been made in the direction of determining the reason of the occurrence of these substances and the part that they play in the economy of the plant. One of the most typical of these substances is chlorophyll. Chlorophyll, which occurs in nearly all plants, is essential to the function of assimilation, *i.e.*, the decomposition of carbonic acid and the formation of starch in the cell, this process being accompanied by the liberation of oxygen. As early as 1690 it was observed by a French botanist that bubbles of gas were given off by green leaves submerged in water; it was next noticed that if the water had been previously boiled no gas was evolved. Priestley found that the gas given off by leaves in sunlight was of

a "purer and better nature," *e.g.*, air which could not support combustion could be so purified by introducing a green plant and exposure to sunlight as to be again capable of supporting life and combustion. The next point noticed was that some sort of proportion existed between the amount of "fixed air" (CO_2) present and the "dephlogisticated air" given off. De Saussure then observed that this process was accompanied by an increase of weight in the plant. Our knowledge of the subject remained at this point till about 1837, when the circulation of starch granules was discovered and their development studied. Sachs next took up the subject and proved that starch grains were not formed in plants which are bleached from the absence of light, and that their formation in the chlorophyll corpuscles depended on the exposure of the plant to bright sunlight. Godlewski proved that if no carbonic acid was present no starch grains were formed. So we have two sets of phenomena, namely, the evolution of oxygen with absorption of carbonic acid, and the formation of starch, for both of which three conditions are essential, viz., sunlight, chlorophyll, and carbonic acid. So we may justly conclude that the two sets of phenomena belong to the same function. Starch is not the only product of this assimilation. In the onion we find no starch, but in its place another carbohydrate grape sugar. Some experiments of Briosi, which seemed to show that substances other than carbohydrates are formed—*e.g.*, oil drops—have been lately disproved by more exact observations of Godlewski. So that as far as we know the only substances formed as a consequence of assimilation are carbohydrates, and to their formation, therefore, the increase of weight of the plant is due. De Saussure found that a plant increased in weight 531 grms., whilst the carbon in the carbonic acid was 217 grms. These numbers fairly correspond with the increase supposing the carbon to unite with hydrogen and oxygen to form starch; thus—$C_6H_{10}O_5 = 162$ to $C_6 = 72$. The next points are—What is the function of chlorophyll, and what part does it play in the formation of starch? As regards the composition of chlorophyll we have but little information. There are at present several distinct views as to its proximate composition; one that it is a definite and distinct chemical entity; the second, that it is a mere mixture of colouring matters, or rather of two groups of colouring matters, one group being blue and to which the name cyanophyll is applied, the other is yellow and is termed xanthophyll. Another view, supported by Pringsheim, Karl Kraus, &c., holds that chlorophyll is nothing less than the cyanophyll of other observers, whilst the xanthophyll is a distinct substance which is a product of the degradation or formation of chlorophyll, but forms no integral part of it. The same diversity of evidence prevails with the ultimate constitution of chlorophyll; according to Pfaundler it contains 0·37 per cent N, other results give 7 per cent, whilst a Russian observer, Timiriazoff, believes it to be an ammoniacal compound, and has called it chlorophyllin. One point seems to be agreed upon by all observers, viz., that it contains iron in its molecule. The opinions which prevail as to its action are various. Wiesner thinks that the growing cells absorb CO_2 from the air, that the chlorophyll combines with the O, whilst CO unites with the elements of water to form carbohydrates. The chlorophyll in its turn is deoxidised, and the oxygen thus set free evolved by the plant. So that according to this view chlorophyll acts as a carrier. Karl Kraus suggests that the process is one of reduction and that chlorophyll is formed by the combination of a substance, leucophyll (for whose existence there is no experimental evidence), with the products formed by the reduction of the carbonic acid absorbed from the air. The chlorophyll is then split up by the action of light into leucophyll and other bodies, the latter forming starch; the leucophyll re-combines, and so the process goes on continuously. According to Sachse, chlorophyll is a product of assimilation, and by the further action of light is converted into starch. By the action of purpurol on resorcin colouring matters more or less remotely resembling chlorophyll have been formed. It is known, moreover, that carbohydrates can be oxidised into aldehyds and aromatic substances. From some experiments of Karl Kraus it is probable that some substance resembling an aldehyd exists in seedlings, while Gorup-Besanez has detected pyrocatechin in plants; some results of Karl Kraus seem to show that in seedlings an aldehyd and an aromatic substance unite in the dark to form ætiolin, but in the light to form chlorophyll; so that on the whole there is some foundation for the theory of Sachse, which may be summed up thus:—That seedlings have the power of decomposing their stored up carbohydrates, forming acids and aromatic substances; the former are reduced to aldehyds, uniting with the latter to form chlorophyll (and in the dark ætiolin), the ultimate product being again starch. If we trace out the probable destiny of the carbohydrates we find that one portion is used to build up the vegetable cell wall, and is there deposited as lignin, &c.; a second part combines with nitrogen to form protein, but of the seat of formation of this protein we have no idea; whilst a third portion is decomposed into chlorophyll for the newly formed parts of the plant. If any excess remains it seems to be stored up for another year. The Lecturer then concluded this portion of the subject, merely pointing out how much remains to be done before conclusions can be arrived at with any certainty.

In the second part of the lecture Mr. Vines considered the origin of vegetable acids and their bearing on the first part of his discourse. Liebig and Mulder from observations on the ripening of fruits came to the conclusion that acids were the first products of assimilation, and from these the carbohydrates were formed. This theory breaks down under the test of experiment, and then the question arises by what process are the acids formed in the plant if not by assimilation? Hoppe-Seyler by the decomposition of sugar with alkalies in the absence of air has produced formic acid and pyrocatechin. Karl Kraus has observed in the onion, which contains much grape sugar, that from the external dry scales much pyrocatechin can be obtained; these dry scales also have deposits of calcium oxalate, whilst the internal scales contain only sugar, so that here the sugar is decomposed into an oxalate and an aromatic substance. In the germination of leguminous plants a substance occurs, asparagin, which has much significance in vegetable physiology. It has been found that in the germination of the leguminosæ the amount of nitrogen in the seed does not vary; the nitrogenous substance of the seed is oxidised into asparagin with the evolution of CO_2. If the germination is in the dark the asparagin accumulates, but when the plant is exposed to light the asparagin disappears and the plant forms carbohydrates. It has been suggested that asparagin is formed by some process analogous to that of digestion. It is known that some seeds contain a peptic ferment, and that aspartic acid is formed when gluten is digested by the pancreatic ferment, so that the suggestion is not without some foundation. The Lecturer concluded with some remarks as to the proximate composition of seeds, about which much uncertainty exists. It is stated that seeds contain much legumin. By some of Hoppe-Seyler's pupils legumin is said to be a sort of globulin. The solanin from potatoes is now believed to resemble asparagin rather than belong to the alkaloid family. Chenopodin from the chenopodium has been said to be identical with leucin. In concluding, the lecturer said that his principal objects had been to sketch the points of contact between vegetable physiology and chemistry, and to point out the sort of information which the vegetable physiologist was most desirous of obtaining from the chemist.

The PRESIDENT said that in listening to the Lecturer three points had especially attracted his notice—(1) That the subject of vegetable physiology was of great interest from a chemical point of view; (2) that the subject was one of which the Fellows very rarely heard anything;

and (3) the very great clearness and ability with which Mr. Vines had introduced and handled the subject.

Dr. Gilbert could but agree with the President in thanking Mr. Vines for his lucid account of what is known, as well as for showing us our lack of knowledge, and indicating to us the lines of work which it was specially necessary to follow up. Mr. Vines, though principally directing his attention to the assimilation of carbon, had not omitted to refer to the assimilation of nitrogen, which from one point of view was even of greater importance. If he might suggest a line of research which would be of the utmost importance to agriculture, as well as interesting to the vegetable physiologist, he would recommend an investigation, especially as regards nitrogen, in plants, from the seed upwards, belonging not only to the Leguminous order, but also to some widely different order, *e.g.*, a Gramineous plant.

Mr. Kingzett could but notice how much speculation existed in the various theories which had been brought before the Society. In his opinion much might be learned by studying the products of chlorophyll when acted on by different reagents. He also called attention to the great want of analytical data in the papers of Hoppe-Seyler's pupils which Mr. Vines had referred to.

Prof. Thistleton Dyer pointed out that for the study and elucidation of these processes all the delicacy of the histologist and all the analytical skill of the chemist were required. The subject could either be investigated by the vegetable physiologist from a morphological aspect, or by the chemist who concentrated his attention on the products of the machine. The latter investigator was sometimes too apt to consider vital products as substances which could be split up by reagents. This method, although giving us much information as to the substances when dead, often furnished us with but little knowledge of their condition when alive. Some substances which were of the greatest importance to the chemist, &c., were of little interest to the vegetable physiologist, and were viewed by him as mere excretions. Thus, the cinchona alkaloids seemed to be merely casual secretions in the bark of some plants, and if the bark containing all these valuable alkaloids were removed the plant seemed none the worse. The great problems are—How does a plant get its living? and how does it assimilate its food? It seemed to the speaker that chlorophyll brings up vegetable life to a point where fungoid growth starts. Thus, if we cut through the stem of a tree we find the outside parts green, the inside parts white, and feeding on the nourishment afforded by the external layers.

Prof. Church said that mucilage was transformed in a manner similar to starch. This was proved by experiments with the seeds of the flax plant, which contain mucilage but no starch.

Mr. Vines, in reply, thanked the Society for the kind interest with which they had listened to his lecture, and reiterated his desire for the cordial co-operation of the chemist and the vegetable physiologist. With reference to Mr. Kingzett's remarks as to speculation, he would only say that the vegetable physiologists would be only too glad to build their theories on more facts when the chemists furnished them.

After a vote of thanks to Mr. Vines for his lecture, the Society adjourned to May 17, when the following papers will be read:—"On a Method of Determining High Boiling-points," by Messrs. Carnelly and Carleton Williams; "On Sage-Oil," by Messrs. Muir and Suguira; "On High Melting-Points," by Dr. Carnelly.

Influence of Plants in Rooms.—"The hygienic influence of plants in rooms" forms the subject of a special chapter, which has been written for the forthcoming illustrated edition of Mr. Francis George Heath's "Fern Paradise"—a "Plea for the Culture of Ferns."

TYNE CHEMICAL SOCIETY.

*Inaugural Address,**

By John Affleck, M.A., D.Sc., President.

Sulphuric Acid.

(Continued from p. 171.)

3. *Calculation of Acid Productions.*—Notwithstanding the apparent simplicity of the thing, and the confident way in which it is often spoken about, it is really difficult to ascertain very accurately, by measurement, the quantity of O.V. made. One part of the difficulty arises from the chambers being such large and shallow reservoirs, that the smallest error in gauging the depth, either from inaccuracy of observation or from the chamber floor being out of level, will affect the cubical measurement very considerably. Another is due to the fact that the acid on the floors varies in strength from one point to another, rendering it next to impossible to draw a sample of the true average strength from the chamber. These errors, due to stock-taking, no doubt, become of small moment when the production is taken over a longer period, though they often make sad havoc of the weekly returns.

But the main source of the difficulty remains. All the acid run from the chambers may be very correctly measured and sampled in proper cisterns, but it has then to be calculated into O.V.

Here the discrepancies of the different tables used by manufacturers come into play; while their methods of applying the figures they find in their tables to the purpose in hand are also so various that it would be difficult to get any three acid makers, from different works, to agree as to the O.V. contents of a cistern full of acid.

It follows that, until some more uniform and accurate means of calculating O.V. by measurement is generally adopted, it is well to control the usual returns by some other method. The sulphate made from a ton of pyrites is a thing very easily found by taking the most ordinary care and precautions; and this is a figure which should appear in the produce sheet of every alkali works, as showing the economy of material in the whole salt cake process. But, strictly speaking, it gives only negative information about the chamber working. When *high*, it proves that the chambers cannot be doing bad work; but when *low*, it may be, *not* because *less* acid is being made from the pyrites, but because *more* of it is wasted in decomposing the salt.

Hence the importance of determining the loss of sulphurous acid in the waste gases of the chambers, as a check upon the acid produced by measurement. Mr. Mactear, of Charles Tennant and Co., in a very able and interesting paper read before the Newcastle Chemical Society, in March last, has treated this subject in a most exhaustive manner. The paper being in the hands of most of you, I need not describe the apparatus he has devised for continuous testing of the waste gases. It is fitted up in very fine style at the Hebburn Works, where it is constantly in use, and, I am sure, Mr. Stuart will be very happy to show it to any of you.

In showing how, by means of the percentage of oxygen in the waste gases, the quantity of sulphur found to be escaping, per cubic foot, is to be calculated into the percentage on the total sulphur, Mr. Mactear has involved himself in unnecessary complications in the calculation. He estimates first, the nitrogen due to the combustion of one ton of pyrites; from that, by the help of a constant depending on the percentage of oxygen in the escaping gases, the air associated with that nitrogen; and, by adding the two together, obtains "the total volume of residual escaping gases from one ton of pyrites."

Now it appears to me to be a much simpler way to start with the percentage of oxygen in the waste gases, as

* Delivered October 12, 1877.

given by experiment, and denoting that varying quantity by a general expression (say V), to work backwards, step by step, till a formula is got for the "total sulphur," or "sulphur burnt" per cubic foot of the escaping gases. Thus:—

Let V = vol. per cent of oxygen in escaping gases. Then per cub. ft. of escaping gases at ordinary temperature and pressure (760 m.m., 15·5° C.). Oxygen fixed in kilns and chambers will be—

$$\frac{1728}{79\cdot2} \times (20\cdot8 - V) \text{ cubic inches.}$$

or—

$$\frac{1728}{79\cdot2} \times \frac{273}{288\cdot5} \times (20\cdot8 - V) \text{ cub. inches at 760 m.m. and 0° C.}$$

One litre oxygen at 760 m.m. and 0° C. weighs 1·430 grms., and 1 litre is equal to 61·02 cubic inches; therefore the above volume of oxygen would weigh—

$$\frac{1728}{79\cdot2} \times \frac{273}{288\cdot5} \times \frac{1\cdot430}{61\cdot02} \times (20\cdot8 - V) \text{ grms.}$$

Assuming sulphur in pyrites to exist as FeS_2 and perfect oxidation to take place, 1 part O burns 1 part FeS_2, or 0·533 part S; therefore "sulphur burnt" by above weight of oxygen, and corresponding to one cubic foot of waste gases,

$$= S_1 = \frac{1728}{79\cdot2} \times \frac{273}{288\cdot5} \times \frac{1\cdot43}{61\cdot02} \times 0\cdot533 \times (20\cdot8 - V) \text{ grms.}$$

$$= 0\cdot257885\ (20\cdot8 - V) \text{ grms.}$$

Or, assuming that "sulphur burnt" is to "total sulphur" as 45 : 47·5; "total sulphur" per cubic foot of waste gases will be—

$$= S_2 = 0\cdot257885 \times \frac{47\cdot5}{45\cdot0} \times (20\cdot8 - V)$$

$$= 0\cdot272212\ (20\cdot8 - V) \text{ grms.}$$

From these formulæ I have calculated for use the following table, showing for each value of V, from 5 to 15, both the "sulphur burnt" and the "total sulphur" in grms. per cubic foot of the waste gases.

Vol. of Oxygen in Waste Gases.	"Sulphur Burnt" per c. ft. of ditto.	"Total Sulphur" per c. ft. of ditto.
5 per cent	4·0746 grms.	4·3009 grms.
6 ,,	3·8167 ,,	4·0287 ,,
7 ,,	3·5588 ,,	3·7565 ,,
8 ,,	3·3009 ,,	3·4843 ,,
9 ,,	3·0430 ,,	3·2121 ,,
10 ,,	2·7852 ,,	2·9399 ,,
11 ,,	2·5273 ,,	2·6677 ,,
12 ,,	2·2694 ,,	2·3955 ,,
13 ,,	2·0115 ,,	2·1232 ,,
14 ,,	1·7536 ,,	1·8150 ,,
15 ,,	1·4957 ,,	1·5788 ,,

With this table nothing else is necessary but to find by experiment the percentage of oxygen, and the sulphur and nitrous compounds per cubic foot of the escaping gases, in order to arrive, by the simplest calculation, at the percentage loss of sulphur and nitre in the chamber exits.

Testing in this way will undoubtedly prove of great service to the acid maker; and if done continuously, it will serve two very important ends; the first, to serve as a check on the production of acid calculated from measurement; and the second, to act as a tell-tale against the chamber foreman, that he does not neglect the chambers and allow them to get out of order during the absence of the manager. More than this it cannot do; it cannot in any way assist the manager in controlling the working of the chambers by inspection in the usual way. Hence I cannot admit that my experience accords with Mr. Mactear's when he states at the end of his paper, that he found it "practically impossible to obtain steady results from sulphuric acid chambers worked on the ordinary system of inspection alone, &c.," unless by these expressions he only means to imply the too frequent carelessness and incompetence of chamber foremen and managers. It is certainly as easy to recognise by the eye, or even by the senses of smell or touch, an internal disorder in the chambers, as it is, a "green" batch of sulphate, a too "florid" ball, or a cone of "bilious" or "jaundiced" soda. Of course, with carelessness in the supervision the chambers will give bad results, just the same as any other department of the works. But with ordinary intelligence and care the trained foreman can readily detect, either by day or night, the first symptoms of the process getting wrong, and by immediately applying the remedy, effect a very speedy cure, before the disorder has had time to extend to the end of the series and result in an escape of sulphur; which, if it did occur, would be the first indication of the disorder that the test would give us, and that perhaps a whole day after its occurrence.

The determination of the oxygen is an important step, as you will observe, in this method of testing the escapes. A quick and handy, yet reliable method of determining oxygen in gaseous mixtures has long been a desideratum with the technical chemist. Various methods of absorption have been proposed from time to time, especially by German chemists; but all of them have proved either too tedious, or to require too complicated and fragile apparatus for the rough usage of a chemical works laboratory The phosphorus method is the one hitherto most commonly employed in chemical works; but it is both tedious and inaccurate, and the introduction of the phosphorus into the gas is rather an awkward operation. The method proposed by Vogt, using freshly precipitated protoxide of iron, also fails to give speedy results. Vogt himself declares that, with frequent shaking and using large excess of the protoxide, he could not complete the determination of the oxygen in the air in less than a day. Scheurer Kestner proposed another method, using nitric oxide (N_2O_2). But Max Liebig, who examined this method carefully, found that, though rapid enough, it was far from accurate. Scheurer-Kestner had assumed that when this gas is added to a gaseous mixture containing oxygen, only N_2O_4 is formed, and decomposed by the water into N_2O_3 and N_2O_5. But Max Liebig found that this was by no means the case; but that quantities of N_2O_3 were also formed, according to the relative proportions of the oxygen and nitric oxide presented to each other. Hence the decrease in volume, due to absorption, would in this case represent varying quantities of oxygen, according to the proportion of nitric oxide added. The last-mentioned chemist has also devised an apparatus for this purpose, employing the old absorbent, alkaline solution of pyrogallic acid. But it is much too complicated to be useful in a technical sense.

At last, however, we have got an apparatus which, I think, fully answers the requirements of the manufacturing chemist, as regards both simplicity and exactness, and which, I have no doubt, will soon find its place in every well appointed laboratory. I allude to the gas apparatus patented by M. Coquillon, a French chemist, and beautifully made by Alvergniat Frères, of Paris. It has been introduced this year on the Tyne, and was exhibited at the recent meeting of the Iron and Steel Institute in Newcastle. By the kindness of Messrs. Mawson and Swan, I am able to show it here to-night. In this form it strikes me as the real "multum in parvo" of a gas apparatus, being adapted for determining not only oxygen but also carbonic oxide, carbonic acid, hydrogen, and nitrogen in a gaseous mixture. If it is required for only one gas at a time, but one of the three absorbing tubes is needed. For oxygen the absorbing agent employed is either alkaline pyrogallate or ammonio-subchloride of copper. The latter, however, is much to be preferred of the two, as the copper sub-salt is being constantly renewed, and the solution thereby kept in the same state of efficiency by means of a close roll of fine copper gauze inserted in the absorbing tube. The latter dips with its open end downwards into a wider tube acting as a reservoir for the solu-

tion, and is connected by a strong yet fine capillary glass tube, leading out of its upper end, and provided with a well-ground glass tap, with the upper end of the measuring tube. The gas to be operated on, being measured in the latter over water at the atmospheric pressure, is then, by opening the connecting tap and raising the water bottle (connected by means of a long India-rubber tube with the low end of the measuring tube), driven over into the absorbing tube; the absorbing liquid at the same time rising into the outer reservoir, but leaving the meshes of the copper gauze wetted with a film of it. Here the absorption of the oxygen takes place very rapidly, in fact almost instantaneously, on account of the very large surface of absorbent thus exposed to the gas. By moving the water bottle slightly up and down for a few seconds, the gas is kept circulating among the meshes of the gauze, and total absorption hastened. Then by lowering the bottle the residual gas is again displaced from the absorbing tube by the rise of the copper solution. When this latter has reached exactly the same point of the capillary tube as it stood at before, the tap is closed, and the remaining gas measured once more under the same conditions: the difference of the two measurements gives the oxygen absorbed.

I have tested an apparatus of this sort (more roughly constructed but on the same principle) with determination of oxygen in the air, and found it to give surprisingly accurate results in a very short time. Five minutes I found amply sufficient for one determination, either in air or any other gaseous mixture. In the case of air a long string of determinations one after another, made as rapidly as possible and with no particular care, gave results all within one-half per cent of the truth, but more frequently giving either the exact figure, 20·8, or a tenth per cent less or more. These facts sufficiently vouch for the rapidity and accuracy of the method. Being so rapid there need not be any change of temperature superinduced in the gas between the two measurements. To prevent, however, the possibility of this taking place, so as to affect the accuracy of the results, the measuring tube might easily be jacketed with water, and a fine thermometer kept suspended in the latter.

When employing this apparatus to determine the percentage of oxygen in the chamber escapes, I found that, to adjust the apparatus, go and collect the sample of gas, transfer it to the measuring-tube, measure, absorb, and measure again, not more than a quarter of an hour to twenty minutes was needed. I also found that, at the Jarrow Works, the oxygen in the escapes of different sets, at different times, varied between 8½ and 11½ per cent, though 9 per cent was about the average when the draughts were not excessive.

By testing the chamber outlets continuously, in the way described, Mr. Mactear has found that, with steady working, the average loss of sulphur is about one-half per cent of the sulphur burnt; and I am informed by Mr. Stuart that that is also about the average of their loss at the Hebburn Works during many months continuous testing.

It is interesting to compare these very excellent results, which, I have no doubt, are quite equalled in many other acid plants, with the very deplorable state of matters disclosed by the table of figures, given by Dr. Angus Smith, in his Report for 1871. These figures show the quantities of the two sulphur acids per cubic foot of the waste gases which he found escaping from a large number of vitriol plants over the country. The number of escapes tested was fifty-three. The average of the total sulphur acids as SO_3 in grains per cubic foot of the waste gases was 8·3484, equal to 3·339 grs. sulphur. Calculating this into the percentage escape on sulphur burnt, according to the table I have given (allowing 10 per cent oxygen in waste gases), we have 3·339 grs. lost per 42·9 burnt, or about 7·7 per cent. More surprising even than this very high average is the immense difference shown between the best and the worst by his figures, the minimum being represented by 0·1648, and the maximum by 51·7931 grs. SO_3 per cubic foot, or, calculated in the same way as before, into per cents, 0·15 per cent and 47·65 per cent. Of the fifty-three eleven are under ½ per cent; six under 1 per eent; one over 5 per cent and under 10 per cent; two over 10 per cent and under 15 per cent; eight over 15 per cent and under 20 per cent; and seven over 20 per cent. If we are to credit these figures that in the year 1871 of fifty-three works examined fifteen were allowing more than 15 per cent of all the sulphur they burnt to escape up the chimney, what a revelation it would be of the utter and reckless mismanagement of many acid plants at that time. It is to be hoped that the Alkali Inspector cannot point to any tests at all like these now-a-days.

(To be continued.)

CORRESPONDENCE.

RELATION BETWEEN GASEOUS VOLUME AND VALENCY.

To the Editor of the Chemical News.

SIR,—I do not know if it has been pointed out that there may be a simple relation between the volumes of a gas and the valency of its atoms. We know if we take two atoms of hydrogen gas = 2 vols. at a certain pressure, we must double the pressure to reduce it to half its volume. Also if we combine one atom of oxygen = 1 vol. with two vols. of hydrogen, the three volumes are reduced to two. Now, if we suppose that one atom of oxygen is not only equivalent to two of hydrogen in the sense of combining with them, but also that it exerts twice the attractive energy on each atom, then the two atoms of hydrogen will be drawn together by a double force, and the two volumes will be reduced to one, which, with the one of oxygen, makes up the two volumes of H_2O gas we find by experiment.

In the same manner, nitrogen being equivalent to three atoms of hydrogen, will attract each atom with energy three times as great as hydrogen for hydrogen, and thus reduce the 3 vols. to one, and so on. In the case of such a compound as NO, where the valency of the one is 3, and the other 2, there will be no contraction, because, while the oxygen is attracted by greater energy than when only under its own attraction, and therefore will contract in volume, the nitrogen is attracted by less, and in the same proportion, and will, therefore, expand so that the volume will remain constant. The same relations can be traced in the combinations of compound gases, although not so apparent.

If these relations are real, they would throw some light on such phenomena as the regular increase of density, &c., of the paraffins, by each addition of CH_2, and taken in connection with some views of solution I ventured to put forth in CHEMICAL NEWS, vol. xxxvii., page 47, would aid in explaining what may be called inverted chemical affinity. In this connection allow me to mention that on closer examination into the action of HCl on crystals of $Na_2SO_4 + 10H_2O$, a considerable quantity of NaCl seems to be formed. I hope to continue this investigation shortly.

WILLIAM DURHAM.

Edinburgh, April 30, 1878.

NITRIC ACID IN THE VITRIOL MANUFACTURE.

To the Editor of the Chemical News.

SIR,—I have read with much interest the papers of Mr. G. E. Davis on this subject in your recent issues, and in

the view that such investigations are for the elucidation of truth, and are looked on, when published in your journal, in the light of standard information (as witnessed by their constant republication in other countries), I think it right to call attention to the following points:—

(1.) The reduction of the nitrous compounds to nitrogen or nitrous oxide by hot sulphurous gases is too well established practically to be disposed of in the way Mr. Davies does in his paper, at page 155. In cases where the nitrate of soda is decomposed in pots placed actually in the burners (a very bad plan, but one still sometimes followed), there is most certainly a much larger amount used.

(2) That the nitrous compounds enter the chambers from the Glover towers as N_2O_2 is an assumption difficult to prove, and certainly the statement that "the arsenic which is present in the nitrosulphuric is at the same time reduced to arsenious acid, and as such leaves the concentrating or denitrating tower," is only partially true, arsenic and arsenious acids existing in all the Glover tower acids which I have had examined.

(3.) That the reaction in the Gay-Lussac tower is that of an oxidation of the As_2O_3 by the N_2O_3 present, N_2O_2 escaping in proportion. The amount of As_2O_3, then, which is put down the absorbing column, is the measure of the limit of nitre which can be used. Mr. Davis has by no means proved this assertion, and in the first place it is not the general condition of things that all the arsenic exists as arsenic acid in the nitrous vitriol, and in the second it is not yet proved that it is N_2O_3 which oxidises the As_2O_3, especially in the presence of higher oxides of nitrogen, which are *always* present in the gases escaping from the chambers to the towers, and of which Mr. Davis has shown considerable quantities in the Gay-Lussac acid.

(4.) The basing of such calculations on quantities of one cubic foot, taken three or four times per week, when the amount of gases escaping is measured (as in cases E, F, G) by from 20 to 48 millions of cubic feet per week, is evidently quite unsound, and would in itself render the results of such calculations more than doubtful. The speed of draughts and amounts of oxygen vary very largely, even from hour to hour.

JAMES MACTEAR.

St. Rollox, Glasgow.
May 1, 1878.

NITRE LOSSES IN THE VITRIOL MANUFACTURE.

To the Editor of the Chemical News.

SIR,—Since the appearance of my paper in your issue of the 18th ult., I have received many letters from chemists upon this subject, which leads me to make the following remarks:—

Firstly, I consider to have proved that in the vitriol manufacture, working *without towers*, the whole of the nitre used can be accounted for, as in the instances A, B, C, and D given.

Working *with towers* I do not claim to have discovered where the real loss is. The reaction is not proven between arsenious acid and nitrous anhydride *by laboratory experiments*, and I argue that the loss takes place here, from the observation that the arsenic acid is produced in the tower from the arsenious acid which the vitriol contained, and from finding nitric oxide in the escaping gases. It has been pointed out to me that the arsenious acid was most probably oxidised by N_2O_4. It may be so; then another source of loss must be searched for; but I have pointed out that the loss of N_2O_3 is nearly equal to the amount which would be decomposed by the arsenic run down the absorbing tower—a strange coincidence—and I have also observed in one works that where the amount of arsenic in the vitriol was large, it was impossible to work with the minimum quantity of nitre used by other makers.—I am, &c.

GEORGE E. DAVIS.

Barton Arcade, Manchester.
May 4, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 13, April 1, 1878.

Specific Heats and the Melting Heat of Gallium—M. Berthelot.—M. Lecoq de Boisbaudran having placed at the author's disposal an ingot of gallium weighing 34 grms., he determined its specific heat, both in the solid and the liquid state, and also its melting heat, making use of his ordinary methods with the water calorimeter. Gallium melts at +30°, but it may be kept liquid in a state of superfusion down to near 0°. The specific heat in the liquid state was determined twice, one experiment between 119° and 13°, and the other between 106° and and 12·5°; the value found was 0·0802. The solid specific heat between 23° and 12° was found =0·079. This determination must not be made too near the point of fusion. The melting heat is determined by introducing some crystals into superfused gallium, when the metal crystallises rapidly. At 13° the author obtained the mean result +19·11 cals. This number remains sensibly unchanged at all temperatures between 30° and 0°. If referred to the atomic weight, 69·9, it becomes 1·33 cals. The atomic specific heat in the liquid state =5·59, and in the solid 5·52. This is the same as that of aluminium (5·53) and glucinium 5·64.

Action of Oxygen upon the Acid Chlorides, Bromides, and Iodides of Aluminium.—M. Berthelot.—The displacement of chlorine by oxygen with the formation of alumina should disengage a heat about +34·9. The displacement of gaseous iodine in the same manner liberates +109·5°; an enormous value which explains the ignition of aluminium iodide. The same holds good with the iodides of phosphorus, silicium, arsenic, antimony, and tin, which are all combustible. The displacement of gaseous bromine by dry oxygen liberates +62·2.

Physical Properties and Specific Heat of Glucinium.—L. F. Nilson and O. Pettersson.—Glucinium in its salts presents certain analogies both with the magnesium and with the aluminium group, but no decisive clue is afforded to the true atomicity of the metal, which can only be deduced from its specific heat. The preparation of the metal is difficult; the authors could not succeed in obtaining it from its chloride by the electric method, and they adopted, therefore, the process of Wöhler and Debray, decomposing the chloride with potassium or sodium in a wrought-iron crucible closed with a screw. Glucinium thus obtained is a steel- or tin-grey metal, of the sp. gr. 1·901 at 0°. It is hard and crystallises readily. If melted it breaks under the hammer, and does not fuse at a temperature where salt is readily volatilised. It is inalterable in the air, and even at a red heat in a current of oxygen. Vapour of sulphur does not affect it. Before the oxidising flame it becomes covered with a layer of oxide, but does not take fire. It has no action upon water either warm or cold. It decomposes hydrochloric and hydrosulphuric acid and the alkaline hydrates, hydrogen being evolved very briskly if heat is applied. Nitric acid attacks it more slowly. The sp. gr. of the impure metal being 1·9101, that of pure glucinium from its known composition was calculated at 1·64. The specific heat of glucina

between 0° and 100° is 0·2471. Hence it must be considered analogous to aluminium, its atomic weight being 13·8, and its oxide having the formula Be_2O_3.

A Peculiar Reaction of Certain Polyatomic Alcohols.—D. Klein.—In presence of mannite, boric acid forms energetic conjugated acids. In presence of an alkaline or alkaline-earthy biborate a very large excess of this polyatomic alcohol removes from the biborate a part of this acid in consequence of the tendency of this acid to form a conjugated acid with the base. Water dissociates these compounds.

A New Way of Separating Arsenic from other Metals.—MM. de Clermont and Frommel.—Supposing a mixture of arsenic, antimony, and tin, the whole is converted into sulphides by treatment with sulphuretted hydrogen, after having acidulated with hydrochloric acid, adding also tartaric acid if antimony is present. When the mixture is saturated it is allowed to stand in a warm place till the odour of sulphuretted hydrogen is no longer perceptible, and is then thrown upon a filter and washed with much care, as the least residue of hydrochloric acid would cause a loss of arsenic in the state of chloride. The whole is then transferred into a flask full of water, and heated to a boil. The reaction is more rapid in a retort through which a current of air is passed. If the quantity of arsenic does not exceed 2 decigrms. the distillation of 500 to 600 c.c. of water suffices for the complete dissociation of the sulphides. The residue is then filtered, and the entire quantity of the arsenious acid is found in the filtrate, and determined by the ordinary methods.

On Melilotal.—T. L. Phipson.—Melilotal has the composition $C_{18}H_8O_6$. It differs from coumarin by its composition, its acid reaction with litmus, its odour, and by the fact that its alcoholic solution does not crystallise.

Reimann's Färber Zeitung,
No. 12, 1878.

The students of the University of Berlin celebrated, on the 7th of last month, the sixtieth birthday of Prof. A. W. Hofmann.

The light of Swedish matches is found sufficiently white for comparing colours.

Lake colours are now prepared by dissolving artificial alizarin in a caustic alkali, adding an alkaline aluminate, and precipitating by the addition of a weak acid or an ammoniacal salt.

No. 13, 1878.

Fixation of Eosin upon Cotton.—E. Apelt.—The author shows that the best mordant for eosin upon cotton is acetate of alumina, the pieces or yarns being subsequently taken through a chalk-bath; the colour-bath should contain a little acetic acid. Precipitated silicic acid and other porous bodies are useless.

Rose Bengale.—This is a new dye of a beautiful blue-red colour, a substitution product of fluorescein. Cotton is prepared for its reception by treatment with an emulsive oil, as for Turkey-red dyeing, and subsequent steeping, when dry, in acetate of alumina, a little of which is also added to the colour-bath.

Chrome Residues.—Residues containing chromic oxide derived from the reduction of potassium chromate are of frequent occurrence, *e.g.*, in the manufacture of artificial alizarin. Wagner proposes to treat such with a mixture of soda-lye and potassium ferridcyanide, and thus effect the re-oxidation of the chrome. Or chromic oxide may be heated with soda-lye and bromine may be added in small successive portions till all chromic oxide has disappeared and the liquid becomes clear and yellow.

Caulin is the name given by a patentee to the colouring matter of red cabbage, which he proposes to extract with boiling-water, and to precipitate with certain metallic salts and oxides, using the lakes thus obtained in the arts.

No. 14, 1878.

Ozone is giving its name to various articles with which it has no connection, as, for instance, "ozonite copying ink."

Silicate of soda is recommended for preparing unbleached cottons for the indigo vat.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 13, March 28, 1878.

According to the *Journal d'Oculistique* an obstinate case of neurosis of the eyes has been cured by the use of *yellow* spectacles.

No. 14, April 4, 1878.

This issue contains no original chemical matter.

No. 15, April 11, 1878.

Strange Effects of Lightning.—At Vernon about six years ago lightning fell in a plot of ground planted with gooseberry and cherry trees, making a deep hole in the ground not more than 10 centimetres in diameter. Subsequently the trees have died away in a circle, which extends wider and is now 7 metres in diameter. The question arises why the morbid action is permanent and why the sterility spreads?

A plant named Hoang-man is attracting much attention as a remedy for leprosy.

MEETINGS FOR THE WEEK.

MONDAY, May 13th.—Royal Geographical, 8.30.
TUESDAY 14th.—Civil Engineers, 8.
— Anthropological Institute, 8.
— Royal Institution, 3. "On Some Points in Vegetable Morphology," W. T. Thiselton Dyer, M.A.
WEDNESDAY, 15th.—Society of Arts, 8.
— Pharmaceutical, 8. (Anniversary).
— Meteorological, 8. "Daily Inequality of the Barometer," W. Rundell, F.M.S. "Meteorology of Mozufferpore, Tirhoot, for 1877," C. N. Pearson, F.M.S. "Note on the Great Rainfall of April 10th-11th, as recorded at the Royal Observatory, Greenwich," W. Ellis, F.R.A.S. "Observations of Sea Temperature at Slight Depths," Capt. W. F. Caborne, F.M.S.
THURSDAY, 16th.—Royal 8.30.
— Royal Institution, 3. "On Colour," Lord Rayleigh, M.A.
— Royal Society Club, 6.30.
— Chemical, 8. "The Action of Hypochlorites on Urea," H. J. H. Fenton. "On the Behaviour of Metallic Solutions with Filter Paper; and on the Detection of Cadmium," Thomas Bayley. "On the Action of Bromine on Sulphur," J. B. Hannay. "On the Determination of High Boiling-points," T. Carnelly, D.Sc., and W. C. Williams. "On Essential Oil of Sage," M. M. P. Muir and S. Suguira. "On High Melting-points," T. Carnelly, D.Sc.
FRIDAY 17th.—Royal Institution, 8, Weekly Meeting. "On Speech," Prof. Graham Bell, 9.
SATURDAY, 18th.—Royal Institution, 3. "On Richard Steele," Prof. Henry Morley.

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THE CHEMICAL NEWS.

VOL. XXXVII. No. 964.

ON THE ACTION OF SONOROUS VIBRATIONS IN VARYING THE FORCE OF AN ELECTRIC CURRENT.*

By Professor HUGHES.

THE introduction of the telephone has tended to develop our knowledge of acoustics with great rapidity. It offers to us an instrument of great delicacy for further research into the mysteries of acoustic phenomena. It detects the presence of currents of electricity that have hitherto only been suspected, and it shows variations in the strengths of currents which no other instrument has ever indicated.

It has led me to investigate the effect of sonorous vibrations upon the electrical behaviour of matter. Willoughby Smith has shown that the resistance of selenium is affected by light, and Börnstein has led us to believe that many other bodies are similarly affected. We know also that the resistance of all bodies is materially influenced by heat. Sir William Thomson and others have shown that the resistance to the passage of currents offered by wires is affected by their being placed under strains, and, inasmuch as the conveyance of sonorous vibrations induces rapid variations in the strains at different points of a wire, I believed that the wire would vary in its resistance when it was used to convey sound. To investigate this I made a rough-and-ready telephone, with a small bar-magnet 4 inches long, half the coil of an ordinary electro-magnet, and a square piece of ferrotype iron 3 inches square, clamped rigidly in front of one pole of the magnet between two pieces of board. When using the pendulum beats of a small French clock, or the voice, as a source of sound, I found this arrangement supplied me with an extremely delicate *phonoscope* or sound detector.

All the experiments detailed in this paper were made with the simplest possible means, and no apparatus of any kind constructed by a scientific instrument maker was employed. The battery was a simple Daniell's cell, of Minotto's form, made by using three common tumblers, a spiral piece of copper-wire being placed at the bottom of each glass and covered with sulphate of copper, and the glass being then filled with well moistened clay and water. A piece of zinc as the positive element was placed upon the clay. Insulated wires were attached to each plate, and three of these cells were joined in series. All experiments were made on a closed circuit, the telephone being used as a phonoscope to detect variations in the current and the consequent reproduction of sound. The apparatus, or materials experimented upon, were used in the same way as the transmitter of the speaking telephone of Bell.

I introduced into the circuit a strained conductor—a stretched wire—listening attentively with the telephone to detect any change that might occur when the wire was spoken to or set into transverse vibrations by being plucked aside. Gradually, till the wire broke, the strain was varied, but no effect whatever was remarked except at the moment when the wire broke. The effect was but momentary, but invariably at the moment of breaking a peculiar "rush" or sound was heard. I then sought to imitate the condition of the wire at the moment of rupture by replacing the broken ends and pressing them together with a constant and varying force by the application of weights. It was found that if the broken ends rested upon one another with a slight pressure of not more than one ounce to the square inch on the joints, sounds were distinctly reproduced, although the effects were very imperfect.

It was soon found that it was not at all necessary to join two wires endwise together to reproduce sound, but that any portion of an electric conductor would do so even when fastened to a board or to a table, and no matter how complicated the structure upon this board, or the materials used as a conductor, provided one or two portions of the electrical conductor were separated, and only brought into contact by a slight but constant pressure. Thus, if the ends of the wire terminate in two common nails laid side by side, and are separated from each other by a slight space, were electrically connected by laying a similar nail between them, sound could be reproduced. The effect was improved by building up the nails log-hut fashion, into a square configuration, using ten or twenty nails. A piece of steel watch-chain acted well. Up to this point the sound or grosser vibrations were alone produced, the finer inflections were missing, or, in other words, the *timbre* of the voice was wanting, but in the following experiments the *timbre* became more and more perfect until it reached a perfection leaving nothing to be desired. I found that a metallic powder such as the white powder—a mixture of zinc and tin—sold in commerce as "white bronze," and fine metallic filings, introduced at the point of contact, greatly added to the perfection of the result.

At this point articulate speech became clearly and distinctly reproduced, together with its *timbre*, and I found that all that now remained was to discover the best material and form to give to this arrangement its maximum effect. Although I tried all forms of pressure and modes of contact, a lever, a spring, pressure in a glass tube sealed up while under the influence of strain, so as to maintain the pressure constant, all gave similar and invariable results, but the results varied with the materials used. All metals, however, could be made to produce identical results provided the division of the metal was small enough, and that the material used does not oxidise by contact with the air filtering through the mass. Thus platinum and mercury are very excellent and unvarying in their results, whilst lead soon becomes of such high resistance through oxidisation upon the surface as to be of little or no use. A mass of bright round shot is peculiarly sensitive to sound whilst clean, but as the shot soon become coated with oxide this sensitiveness ceases. Carbon, again, from its surface being entirely free from oxidation, is excellent, but the best results I have been able to obtain at present have been from mercury in a finely divided state. I took a comparatively porous non-conductor, such as the willow charcoal used by artists for sketching, heating it gradually to a white heat and then suddenly plunging it in mercury. The vacua in the pores, caused by the sudden cooling, became filled with innumerable minute globules of mercury, thus, as it were, holding the mercury in a fine state of division. I have also tried carbon treated in a similar manner with and without platinum deposited upon it from the chloride of platinum. I have also found similar effects from the willow charcoal heated in an iron vessel to a white heat, and containing a free portion of tin, zinc, or other easily vapourised metal. Under such conditions the willow carbon will be found to be metallised, having the metal distributed throughout its pores in a fine state of division. Iron also seems to enter the pores if heated to a white heat without being chemically combined with the carbon as a graphite, and, indeed, some of the best results have been obtained from willow charcoal containing iron in a fine state of division.

Pine charcoal treated in this manner (although a non-conductor as a simple charcoal) has high conductive powers, due to the iron; and from the minute division of the iron in the pores, is a most excellent material for the purpose.

Any one of these preparations confined in a glass tube or a box, and provided with wires for insertion in a circuit, I call a "transmitter."

Reis, in 1860, showed how, by the movement of a dia-

* A Paper read before the Royal Society, May 9, 1878.

phragm, intermittent voltaic currents could be transmitted, agreeing in exact number with the sonorous waves impinging on the diaphragm, and thus reproducing music at a distance by causing an electro-magnet to vibrate in unison with the diaphragm; and, with an iron diaphragm, Graham Bell showed how the vibrations of that diaphragm in front of a polarised electro-magnet could similarly induce magneto-currents, corresponding in number, amplitude, and form, with the sonorous vibration, and thus reproduce all the delicacies of the human voice. Edison and others have produced variations in the strengths of a constant current by causing the diaphragm to press directly upon some elastic conductor, such as carbon, spongy platinum, &c., the varying pressure upon these materials varying the resistance of the circuit, and consequently the strength of current flowing. Graham Bell and others have produced the same effect, by causing the vibrations of the diaphragm to vary the electromotive force in the circuit. It will be seen, however, that in the experiments made by myself, the diaphragm has been altogether discarded, resting as it does upon the changes produced by molecular action, and that the variations in the strengths of the currents flowing are produced simply and solely by the direct effect of the sonorous vibrations.

I have found that any sound, however feeble, produces vibrations which can be taken up by the matter interposed in the electrical circuit. Sounds absolutely inaudible to the human ear affect the resistance of the conductors described above. In practice, the effect is so sensitive, that a slight touch on the board, by the finger nail, on which the transmitter is placed, or a mere touch with the soft part of a feather, would be distinctly heard at the receiving station. The movement of the softest camel hair-brush on any part of the board is distinctly audible. If held in the hand several feet from a piano the whole chords—the highest as well as the lowest—can be distinctly heard at a distance. If one person sings a song, the distant station, provided with a similar transmitter, can sing and speak at the same time, and the sounds will be received loud enough for the person singing to follow the second speech or song sent from the distant end.

Acting on these facts, I have also devised an instrument suitable for magnifying weak sounds, which I call a *microphone*. The microphone, in its present form, consists simply of a lozenge-shaped piece of gas carbon, one inch long, quarter inch wide at its centre, and one-eighth of an inch in thickness. The lower pointed end rests as a pivot upon a small block of similar carbon; the upper end being made round plays free in a hole in a small carbon-block, similar to that at the lower end. The lozenge stands vertically upon its lower support. The whole of the gas carbon is tempered in mercury, in the way previously described, though this is not absolutely necessary. The form of the lozenge-shaped carbon is not of importance, provided the weight of this upright contact piece is only just sufficient to make a feeble contact by its own weight. Carbon is used in preference to any other material, as its surface does not oxidise. A platinum surface in a finely divided state is equal, if not superior, to the mercurised carbon, but more difficult and costly to construct. I have also made very sensitive ones entirely of iron.

The best form and materials for this instrument, however, have not yet been fully experimented on. Still, in its present shape, it is capable of detecting very faint sounds made in its presence. If a pin, for instance, be laid upon or taken off a table, a distinct sound is emitted, or, if a fly be confined under a table-glass, we can hear the fly walking, with a peculiar tramp of its own. The beating of a pulse, the tick of a watch, the tramp of a fly, can thus be heard at least a hundred miles distant from the source of sound. In fact, when further developed by study we may fairly look for it to do for us, with regard to faint sounds, what the microscope does with matter too small for human vision.

It is quite evident that these effects are due to a difference of pressure at the different points of contact, and that they are dependent for the perfection of action upon the number of these points of contact. Moreover, they are not dependent upon any apparent difference in the bodies in contact, but the same body in a state of minute subdivision is equally effective. Electrical resistance is a function of the mass of the conductor, but sonorous conduction is a function of the molecules of matter. How is it, therefore, that a sonorous wave can so affect the mass of a conductor as to influence its electrical resistance? If we assume a line of molecules, we know that a sonorous wave is accompanied by alternate compressions and rarefactions. If we isolate the part under compression from the part under dilation we vary the dimensions of the mass, and we alter its electrical resistance. In any homogeneous conductor of finite dimensions the effect of the one will exactly compensate for the effect of the other, and we get no variation of current, but if we break up this homogeneous conductor into a series of minute subdivisions without actually breaking their electrical continuity, we destroy its neutralising influence, and we render evident the effect of sonorous vibrations in varying the dimensions of the mass of the conductor, and therefore in varying its electrical resistance, for we reduce the length of a portion of the conductor to a fraction of the length of a sonorous wave. Molecular action alone explains to me all the effects produced. Size or shape does not affect them. A piece of willow charcoal the size of a pin's head is quite sufficient to reproduce articulate speech. I regard the action as follows:—If we have two separate conductors joined simply by contact, this contact offers a certain resistance. Now we can vary or lessen the resistance by increasing the pressure, thus bringing more points in contact or closer proximity. Now, as I employ a constant pressure on the contact, which is exactly under the same influence of the vibrations as the points of contact, more points or closer proximity can only be obtained through the molecular swelling or movement of the contact points.

The tube transmitter, which I exhibit this evening, consists of an exterior glass tube two inches long and one quarter of an inch in diameter. In it are four separate pieces of willow charcoal, each one quarter of an inch long, and two terminals of the same material. The terminals are fastened in the tube, and connect exteriorly with the line and interiorly with the four loose pieces.

The instant the sonorous vibrations pass in the tube there is electric contact to a remarkable degree, which could only have taken place by the molecules enlarging their sphere under the influence of the sonorous vibrations.

It is impossible to say what can be the applications or the effects of the discovery which I have had the honour of bringing before the Royal Society, for the whole question has been studied with crude materials, and scarcely sufficient time has elapsed to enable me to consider its ultimate uses. I do not desire to assert that there is anything in what I have brought forward that is superior to or equal to other transmitters used for telephony. It is as loud and far more sensitive than any I have yet heard, and it may be increased by multiplication of transmitting contacts in quantity or intensity; the loudness is at present limited by the capability of the receiver. The materials at my disposal, and the arrangement of them, have not yet been sufficiently studied. I only wished to show that it is possible to transmit clear and intelligent articulate speech, and to render audible sounds which have hitherto been inaudible by the mere operation of sonorous vibrations upon the conducting power of matter.

My warmest thanks are due to Mr. W. H. Preece, electrician to the Post Office, for his appreciation of the importance of the facts I have stated, and for his kind counsel and aid in the preparation of this paper.

I do not intend to take out a patent, as the facts I have mentioned belong more to the domain of discovery than invention. No doubt inventors will ere long improve on

the form and materials employed. I have already my reward in being allowed to submit my researches to the Royal Society.

NOTES OF WORK DONE IN MESSRS. POKORNY, FIELDER, AND CO.'S LABORATORY.

By E. SONSTADT, F.I.C., F.C.S.

I. On Acetic Acid.

During last summer I made a series of experiments on the freezing-point of acetic acid, pure or glacial, and diluted with successive portions of water, and found that the temperature at which freezing began furnished a very ready and accurate means of determining the percentage of dilution. I was only recently aware that this work had been done (and, I may add, very efficiently done) before me by Rüdorff, an abstract of whose paper on the subject is given in the second supplement to "Watts's Dictionary." I made, however, some observations, not included in Rüdorff's paper, which I trust may be thought of sufficient interest to deserve publication.

Rüdorff's statement that glacial acetic acid may with care be cooled down to 8° without freezing is perfectly accurate. In a sealed bottle I have known the glacial acid to remain throughout a winter, in a room without a fire, in the liquid state; nor did the most violent shaking at about 8° alter its condition. Nevertheless, I found that crystallisation could be immediately induced by placing the vessel containing the acid in contact with a freezing-mixture. Crystals would shoot out almost instantly if the glass was thin, from the chilled part. Another way of inducing crystallisation—quite as effective as the introduction of a crystal—is to introduce a wire, preferably a stout platinum wire, and either let it drop suddenly and sharply to the bottom of the vessel, or rub the end of the wire briskly against the side. If the acid is capable of crystallising at the temperature crystals will immediately shoot out from the points of contact. The wire may be plunged red-hot into the acid and the same result obtained, provided the bulk of fluid is sufficient to prevent the heating from the wire raising the temperature too high for crystallisation to occur: proving that the crystallisation thus induced is independent of nuclei coming from without. Two wires rubbed one against the other in the liquid usually give the same result, though with less certainty, probably because the metal used (platinum) is so much softer than glass. A glass rod may be used in the same way as a wire; but, if the acid is very near the temperature of crystallisation, the rod must be made to rub the side of the vessel with considerable force.

As a definite hydrate of crystallised acetic acid is supposed to be formed when the aqueous solution attains its maximum density, it might be anticipated that the acid of such density would, when cooled down sufficiently, give crystals of such definite hydrate. I found, however, that the acid containing 79 per cent $C_2H_4O_2$, when crystallised even at so low a temperature as 0°, does not give a hydrate, but simply the pure acid. This fact has a practical value, since it shows how readily during winter time a dilute acid may be made to yield a strong acid by simply crystallising and draining off the mother-liquid. It was by many repetitions of this process that I obtained from the ordinary commercial glacial acid the pure acid necessary for my experiments. The pure acid once obtained can only by great care be preserved dry, for it is, I think, as hygroscopic as pure alcohol.

When once it was proved that only the pure acid crystallised out at any temperature down to 0° from a solution of whatever strength that was at all crystallisable it seemed probable that the solid acid would form a freezing-mixture with water or ice, and it proved to be so. In one of the experiments, some crystals having been obtained from a dilute acid by a freezing-mixture (it being summer time, and the temperature of the room above 20°), the mother-liquid was poured off the crystals, and, when these were at a temperature of 4°, some moist fragments of ice were added. The mass became nearly all liquid, and the thermometer sank to −12°, or a depression equal to 16° C. In another experiment 52·24 grms. of the glacial acid were added to 15·92 grms. water, and the solution cooled to −15°. Crystallisation then set in, and the thermometer rose to 0°, the liquid being almost completely full of crystals, although containing much mother-liquid. The flask was cooled to −3°, and ½ c.c. water added. The crystals began sensibly to dissolve, and the thermometer to fall. At −12° another ½ c.c. water was added, and, the flask being in a freezing-mixture at about −12°, a slight further depression of temperature took place, accompanied by further liquefaction of the crystals. The third dose of water again caused depression of temperature, with further solution of crystals, though, meanwhile, the bath of freezing-mixture was in the warm room rising in temperature. Lastly, 1 c.c. of water at about 20° was added, on which the thermometer rose momentarily one degree, sinking immediately afterwards to −15·5°, or a little below the temperature of the bath. The liquid was now very nearly free from crystals. The quantity of water now present in the solution was nearly 18½ grms., and as the quantity of glacial acetic acid taken was nearly 52½ grms., the solution contained about 74 per cent crystallisable acid. Thus it appears that an acid of this strength remains practically liquid at −15° C. Probably at some lower temperature a hydrate would crystallise out.

Rüdorff gives 16·7° as the freezing-point of pure acetic acid. My standard acid crystallised at about 17·5°, but to obtain so high a point I found very difficult, for the last traces of water are obstinately retained. Unless this difference is due to our thermometers not being exactly comparable, Rüdorff's 100 per cent acid would have contained between a third and a half per cent of water. As in the abstract of this chemist's paper already referred to no mention is made of the purity of the standard acid used being ascertained by independent methods, and as I have done so with my acid, I incline to the opinion that Rüdorff's acid was probably not perfectly free from water, though in the absence of the necessary data some doubt on this point must remain.

ON THE SPECIFIC GRAVITY OF SOME SPECIMENS OF BESSEMER STEEL.

By SERGIUS KERN, M.E., St. Petersburg.

In the CHEMICAL NEWS (vol. xxxvii., p. 48) the author described some experiments made with the Bessemer metal, samples of which were obtained from the retort just before the addition of the spiegeleisen.

As it was of some interest to know the specific gravity of such a metal in the forged state, a specimen was hammered under a steam-hammer, and from the bar four pieces were cut and polished in order to examine the specific gravity, which was found to be at 16° C.:—

Samples.		Sp. Gr.
Outside part	I.	7·4821
	II.	7·4902
Inside part	III.	7·5009
	IV.	7·4938

The fact that such a specimen of Bessemer steel has such a low specific gravity, even in a hammered state, may be explained by the porosity and great difficulty in forging such a metal, which in the melted state was not freed from the oxides of iron by the addition of a convenient quantity of spiegeleisen.

Obouchoff Steel Works.

ON THE

CHEMICAL AND MECHANICAL ANALYSES OF CAST-STEELS.

By SERGIUS KERN, M.E., St. Petersburg.

This present paper refers to certain experiments of the author during the last summer, which collected together may be of some interest. In metallurgy there is an open question of great importance—that is, to what extent chemical analyses of cast-steel show the quality of the metal. Most of the steel works having laboratories classify their raw products by analysing them for chemically combined carbon by Eggertz's colorimetric method. This being executed, the raw products are sent to the rolling-mills and machine-shops, and it is only when the desired products are executed that small test-bars are taken from them in order to be mechanically tested. If the material shows inferior qualities it is then analysed in full. But in this case the analysis seldom helps, because good and bad steel often show no difference whatever in chemical composition. This fact is known to many, and this may be easily shown by the following tables. All these steels were used for the manufacture of tyres, axles, and steel-plates for bridges, &c. :—

TABLE A.

(*Steel of Good Quality.*)

Samples. Nos.	Combined Carbon.	Graphite.	Si.	Mn.	S and Ph.	Cu.
1.	0·29	0·01	0·07	0·13	traces	none
2.	0·60	0·03	0·12	0·07	—	—
3.	0·67	0·02	0·16	0·18	none	0·02
4.	0·59	0·02	0·16	0·13	—	none
5.	0·60	0·04	0·16	0·16	—	—
6.	0·47	0·03	0·15	0·24	—	—
7.	0·39	0·05	0·16	0·17	—	0·01
8.	0·50	0·04	0·10	0·18	—	0·03
9.	0·60	0·08	0·15	0·16	—	traces
10.	0·25	0·01	0·03	0·08	—	none

TABLE B.

(*Steel of Inferior Quality.*

Samples. Nos.	Combined Carbon.	Graphite.	Si.	Mn.	S and Ph.	Cu.
1.	0·28	0·03	0·09	0·19	traces	0·01
2.	0·48	0·02	0·16	0·10	none	none
3.	0·44	0·02	0·10	0·12	—	—
4.	0·68	0·02	0·19	0·10	—	0·03
5.	0·44	0·02	0·17	0·12	—	none
6.	0·58	traces	0·20	0·19	—	—
7.	0·38	0·05	0·18	0·13	—	—
8.	0·56	0·01	0·16	0·07	—	—
9.	0·45	0·01	0·15	0·09	traces	—
10.	0·56	0·02	0·14	0·12	—	0·01

In other cases, however, the chemical analyses show very accurately and visibly the difference between good and bad materials:—

	Bad Steel.			Good Steel.		
	I.	II.	III.	I.	II.	III.
Combined carbon and graphite ..	0·53	0·70	0·40	0·49	0·72	0·35
Silicon	0·64	0·61	0·59	0·01	0·06	0·05
Phosphorus	0·03	0·01	0·01	0·03	none	
Sulphur	0·06	none	0·01	0·03	0·01	none
Manganese	0·55	none		0·57	none	
Copper	0·03	none		0·02	none	0·01

In this case the inferior quality of bad steel may be directly attributed to the great quantity of silicon in the presence of an excess of carbon, as it is known that steel may contain 1 to 1·5 per cent of silicon, provided that the quantity of carbon in the steel would be as low as possible. We know that steel containing copper to a certain extent is red-short: metallurgists tell us that 0·3 to 0·4 per cent of copper renders the steel red-short, a quality very noxious in artillery pieces. But several analyses of Krupp's heavy guns show that from steel containing copper capital artillery pieces were manufactured. The following is a table showing the composition of these guns:—

Eight-inch Guns.

	I.	II.	III.	IV.	V.
Combined carbon	0·56	0·64	0·42	0·50	0·69
Graphite	0·04	0·04	0·04	0·02	0·02
Silicon	0·19	0·10	0·11	0·09	0·06
Manganese ..	0·18	0·16	0·13	0·07	0·15
Phosphorus ..	traces		none		traces
Sulphur	—	—	—	—	—
Copper	0·27	0·35	0·30	0·35	0·26

These tables of the chemical analyses of steels show that the steel after casting must be first mechanically tested in the smith's shop, as a clever smith in some minutes will tell for what purpose the steel in hand may be used. If a smith is not believed, Kirkaldy's testing-machine may be used for this purpose.

This opinion does not mean that the chemical analysis of the steel may be neglected; nay, it would be even desirable to analyse every casting, not only for combined carbon, but also for silicon, the quantity of which present often shows the quality of the steel: but in all cases the mechanical test must precede the chemical analysis.

Some years ago, when Eggertz's process was unknown, steel products were ordinarily classified by means of the mechanical test, and seldom faults occurred. Now when the carbon plays a great part in the classification of the raw material, it often happens that steel containing 0·70 per cent of carbon under the steam-hammer behaves as soft steel, and steel with 0·35 to 0·40 per cent of carbon is very hard and hammers very badly. It is, indeed, difficult to know the mean percentage of carbon in the received ingot, when from an ingot weighing often several tons, in most of the works a small sample is taken, from which, for the estimation of the percentage of carbon in the ingot, 0·1 grm. is used.

In conclusion, I will make some remarks on the uniformity of the percentage of carbon in crucible-steel. The just-mentioned misapprehension in the analyses of ingots always happens when puddled-steel is used in preparing cast-steel, because a bar of puddled-steel often shows a great difference in the percentage of carbon in its various parts. In order to avoid this inconvenience, there is only one way—the use of the Bessemer or Siemens-Martin steels. In this way the metallurgist may always closely know how to mix his raw materials in order to receive cast-steel with a certain percentage of carbon.

CONTRIBUTIONS TO BLOWPIPE CHEMISTRY.

FIRST PAPER.—NEW BLOWPIPE BELLOWS.*

By P. CASAMAJOR.

This apparatus works by water pressure. It is formed of two drums, A and B (see fig. 1), connected by a pipe C, open at both ends, which I will call the *water-pipe*. Another pipe D, which I will call the *outlet air-pipe*, is connected with both drums, and serves to carry off the compressed air from the lower drum to the nozzle of the blowpipe. In addition to these, the drum A is provided with a tube E, and the drum B with a tube F, which I will call the *inlet air-pipes*. The function of these is to admit air into the upper drum.

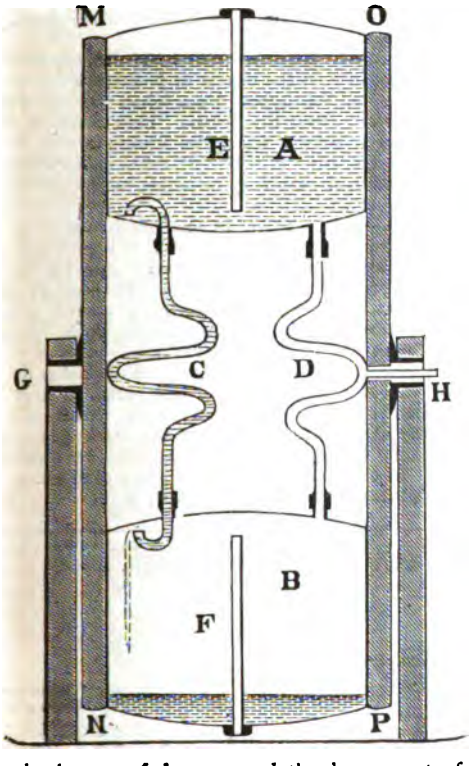
The upper and lower drums are firmly fixed on two upright pieces of wood, M N and O P, which are provided with journals, G and H, which turn in bearings attached to a frame. One of the journals, H, is hollow, and through

* Read before the American Chemical Society, Feb. 7, 1878.

it passes a tube, soldered to pipe D, which serves to carry the air of the lower drum to the blowpipe.

If we suppose that the upper portion of the pipe D and that the pipe F are closed, while the lower part of the pipe D and the pipe E are open, and if, moreover, we suppose that the upper drum A is full of water, while the lower drum B is full of air, we may see that the water in A will run down the water-pipe, C, and fall into the lower drum. This produces pressure in this drum, which drives the air in it to the blowpipe, through the lower part of the pipe D. As the water descends to the lower drum, air is admitted to the upper one through the inlet air-pipe, E, so that finally the lower drum becomes full of water and the upper one full of air. We may then turn the drums on their journals G H, so as to place the drum B above the drum A. If now we close the inlet air-pipe of the lower drum and the upper portion of the pipe D, while we open the

Fig 1.



inlet air-pipe F of drum B and the lower part of the outlet air-pipe D, the water of B, as it descends into A, will drive out the air of this drum to the blowpipe, through the tube D. When this action is over, the apparatus may again be reversed with the same result as before, and so on indefinitely.

It may be noticed, in figure 1, that the tubes C and D are curved instead of being straight. The object of these curves is to prevent the expansions and contractions of these tubes from injuring the drums, as these are held apart by the pieces of wood M N and O P, whose longitudinal expansions and contractions are insignificant when compared to those of the tubes, which are of metal. It may also be noticed that the water-pipe C terminates at each end by a curved portion, the object of which is to keep the lower part of this pipe full of water, when the water runs down to prevent the air of the lower drum from ascending through this pipe into the upper drum.

I have mentioned that it is essential for the proper working of this apparatus, that the upper inlet air-pipe and the lower portion of the outlet air-pipe D should be left open, while the lower inlet air-pipe and the upper part of the outlet air-pipe D should be tightly closed. It would be possible to accomplish these alternate openings and closings of air-pipes by providing each inlet air-pipe with a cock, and the outlet air-pipe D with two cocks, each placed between one of the drums and the middle of the pipe D. By alternately opening and closing these cocks with the hand, the desired object would be accomplished, but it has been found more convenient to use valves, which open and close automatically. As these valves must close very tightly, and with considerable pressure, I use the arrangement shown in figure 2, which works with entire satisfaction.

In figure 1, it may be noticed that the pipes C, D, E, F are enlarged at the portions at which they are inserted

Fig 2.

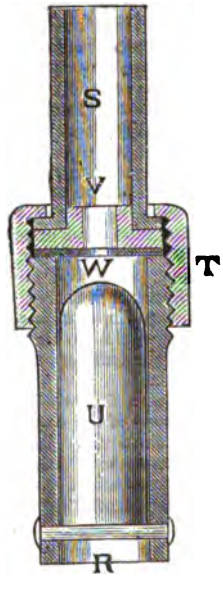


Fig 3.

in the drums. These enlargements correspond to screw couplings, which, in the case of the water-pipe C and the outlet air-pipe D, consist of two tubes, R and S, of which R is provided with a screw. A nut, T, works in the screw of the tube R, and this nut is provided with a shoulder, which presses down on the rim of the tube S, so that by turning this nut, the tubes R and S are brought tightly together. Between these two tubes, in the case of the water-pipe C, there is a washer of rubber or leather to keep the joint from leaking. In the case of the outlet air-pipe D the arrangement adopted is shown in figure 2. Between the tubes R and S, there is a cork washer, V,* cut, as shown in the figure, so that part of it enters in the tube S, while another portion is pressed between the tube R and the rim of the tube S. To the face of this cork

* Since this paper was written, I have found that cork and india-rubber are not sufficiently durable. The piece V should be made of hard wood or metal, and the washer W of leather. V should be perforated to allow W to be stitched on it, and there should be another leather washer between V and the pipe S.

washer, which is turned towards R, is stitched a soft rubber washer, W, about $\frac{1}{16}$ of an inch thick, its diameter being the same as that of the wide part of V. This rubber washer has a hole in its centre about $\frac{5}{16}$ of an inch diameter, while the cork washer has a hole of $\frac{3}{8}$ of an inch diameter.

At the end of the tube R furthest from the screw, a wire is placed in the diameter of the tube and riveted in its place. This wire is to prevent the weight U from falling further down, when placed as shown in the figure 2. This weight is cylindrical, with a hemispherical head at the end, which is turned towards the washer W. The diameter of the weight is slightly smaller than that of the interior of the tube R, that it may move in this tube with ease. The rounded end of this weight is polished, but the cylindrical portion may remain quite rough. The cylindrical portion has two deep grooves, to let the air pass freely from below the weight to the space above it. The function of this cylindrical weight is to close the opening left in the thin rubber washer W. This is easily understood by reversing figure 2, so that the tube R shall be above the tube S, in which case the weight U slips down and closes the opening in the thin rubber washer. The cylindrical weight U is made of an alloy of lead and antimony, which gives sufficient density, combined with hardness. The length of each cylindrical weight is $1\frac{1}{4}$ inches, the diameter being $\frac{1}{4}$ inch. Each one weighs 3 ounces.

An indispensable condition for the proper working of this valve is that the opening in the rubber washer W shall be in the axis of the tube R, as otherwise the weight U will not close this opening perfectly. It is to insure this condition, that a portion of the cork washer V has been given a smaller diameter; that it may be inserted in the tube S, and be kept from moving sideways. By attaching the thin rubber washer to this cork washer by a few stitches of thread, the rubber washer is kept immovable in its proper place.

The arrangement shown in figure 2 is, as I have said, the one adopted at each end of the outlet air-pipe D, the tube R being soldered on the drum. In the case of the inlet air-pipes, E and F, the tube S has been suppressed, and the cork washer is of sufficient diameter to fit in the nut T. The rubber washer is stitched on its under side, as before.

Constant Pressure.—By referring to figure 1, we may notice that the inlet air-pipes E and F are prolonged to nearly the bottom of their respective drums. The object of lengthening these pipes is to insure constant pressure to the blast.

In the positions of things shown in figure 1, the pipe F is closed, but the pipe E is open, and it may be seen that the drum A is equivalent to a *Mariotte's flask*, and the water pressure is represented by the distance from the lowest part of E to the outlet of the water-pipe. In the apparatus which I now exhibit before the society, this height is equal to 15 inches, equivalent to nearly 10 ounces pressure per square inch. Each drum in this apparatus has a diameter of 10 inches and a height of 8 inches.

The duration of the blast depends on the bore of the nozzle. For the small bore used in qualitative blowpipe tests, the drums have to be reversed every 35 minutes. For the bore used in Plattner's quantitative assays, the duration is 20 minutes. For a large flame, fit for glass blowing, using a bore equal to No. 22 wire gauge, the duration is 12 minutes.

Spring-catch.—A necessary feature of this apparatus is a spring-catch, to hold the drums in position while working. Without it, the upper drum when full of water, would not remain above the lower. This catch is freed by pressing on a button when the drums are to be reversed. The operation of reversing takes about a second. As a spring-catch is very easy to make, no detail is given of it in the figure.

Water-trap.—When there is too much water in the drums, and under other conditions, which I have not been able to determine, a little water sputters up with the air, and finds its way to the blowpipe. To prevent this, a trap is conveniently made, as in figure 3, with a glass tube tightly closed at each end by a rubber cork. A tube enters through the middle of each cork, one for the ingress of air from the lower drum, and the other for its egress to the blowpipe. One of the corks is provided with another hole, near its circumference, which may be conveniently closed with a plug of any hard substance, and water may be let out from time to time, by removing this plug. In the bellows I use, the glass tube shown in figure 3 is placed in the hollow journal, H.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

MARCH, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Anhydride. Sulphuric	Hardness on Clark's Scale.	
		Saline.	Organic.								Before Boiling.	After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Clear	0·000	0·007	0·120	0·051	21·20	8·560	0·540	0·94	1·460	13·7	3·30
West Middlesex	Clear	0·000	0·008	0·105	0·062	21·10	8·400	0·570	0·94	1·830	13·7	3·70
Southwark and Vauxhall	Clear	0·000	0·011	0·120	0·061	20·90	8·560	0·420	0·87	1·660	13·2	3·30
Chelsea	Clear	0·000	0·010	0·120	0·048	20·90	8·840	0·540	0·94	1·660	13·7	2·80
Lambeth	Clear	0·000	0·011	0·114	0·062	22·20	8·900	0·360	0·94	1·800	13·7	2·80
Other Companies.												
Kent	Clear	0·000	0·002	0 195	0·000	26·40	10·440	0·570	1·29	2·860	17·0	4·60
New River	Clear	0·000	0·007	0·134	0·024	20·20	8·900	0·360	0·94	1·160	13·7	2·80
East London	Clear	0·000	0·007	0·105	0·032	22·40	9·120	0·640	1·15	2·000	14·3	4·20

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B

CORRESPONDENCE.

BURNARD'S PATENT FOR SUPPLYING SULPHURIC ACID CHAMBERS WITH NITRE.

To the Editor of the Chemical News.

SIR,—The President of the Tyne Chemical Society in his inaugural address, as reported by you in your issue of April 26, makes some criticisms on Burnard's patent for supplying sulphuric acid chambers with nitre in solution, &c.

Permit us to say in reply to Mr. Affleck's observations that, at our Cattedown Works, from their commencement in November, 1876, to the present time (with two very brief interruptions for general repairs), the process has been constantly in use, not a pound of nitre having been potted.

It is silent, continuous, and most effective—the longer we use it the more we are gratified with it.

That imperfect trials, of which the patentee has had no cognisance, may have failed is at once granted, but failure is simply impossible when the apparatus is properly constructed and the details mastered.

To the objection of Mr. Rennoldson, as quoted by Mr. Affleck, we also state as facts that we can and do adjust the steam with the utmost ease and accuracy, and that the strength of our chamber bottoms have all along averaged (within very narrow limits) as follows:—No. 1, 130°; No. 2, 130°; No. 3, 120°; No. 4, 100°. (Twaddel).—We are, &c.,

BURNARD, LACK, AND ALGER.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 14, April 8, 1878.

Extract from a Work Entitled "On the Vision of Colours, and in Particular on the Influence Exerted on the Vision of Coloured Objects in Circular Motion, when they are Observed Comparatively with Identical Objects in a State of Rest."—M. Chevreul.—The author has undertaken the experiments described in his work, because latterly certain *savants* of undeniable merit, in opposition to the ideas of Newton and Arago, have set up the absolutely false hypothesis that the fundamental colours are red, green, and violet, yellow being formed of red and green, and blue of violet and green. The author's experiment are in perfect conformity with the principles of the "optics" of Newton, and with the views of Biot, Arago, and Brewster.

Action of Oxygen upon the Acid Chlorides and Analogous Compounds.—M. Berthelot.—Oxygen displaces chlorine in the perchloride of phosphorus, forming at first phosphorus oxychloride, and finally phosphoric acid. Similar reactions take place with phosphorous chloride, and with the corresponding compounds of bromine and iodine.

Transparence of Coloured Flames.—M. Gouy.—The author's experiments prove the transparence of flame, both for the rays which it emits and for others.

Variation of the Indices of Refraction in Mixtures of Isomorphous Salts.—H. Dufet.—The differences between the indices of a mixture of two isomorphous salts and those of the salts composing it are inversely as the numbers of equivalents of the two salts which enter nto the mixture.

Direct Fixation of Oxygen and Sulphur upon Benzin and Toluen.—MM. Friedel and Crafts.—The general method employed by the authors consists in the use of the metallic chlorides, and in particular of the chloride of aluminium, which serves to attack the hydrocarbon operated upon, and to cause the substitution of one, or of several atoms of hydrogen, by hydrocarbonated or oxygenated groups, or even by elements which are added in the state of chlorides to the hydrocarbide mixed with the chloride of aluminium.

Action of Chloride of Ethyl upon Benzin in Presence of Chloride of Aluminium.—MM. Albright, Morgan, and Woolworth.—The authors have obtained a hydrocarbon corresponding in composition to hexethylbenzin. It crystallises in monoclinar prisms, melts at 123°, and boils at 286°.

On Ergotinin, the Base Present in Ergotised Rye.—M. Tauret.—The composition of this base is represented by the formula $C_{70}H_{40}N_4O_{12}$. Only two of its salts, the sulphate and the lactate, have been obtained in a crystalline state, and not in quantity sufficient for analysis.

Alcoholic Potassa.—E. J. Maumené.—The author maintains that alcoholic solutions of potassa are converted, in course of time, into dihydrodedate of potassa, a neutral anhydrous salt, formed by an acid richer in hydrogen than any other known, $C_4H_8O_4$. This salt is rendered anhydrous by desiccation at 100°. It is deliquescent, especially in moist air, and its solution has a very faint and slightly bitter taste. Its action with metallic salts is very characteristic: if concentrated, it forms in all a magma, very similar to that produced by the mixture of caustic potassa with calcium chloride. If diluted, it precipitates ferric, mercuric, plumbic, and platinic solutions. The ferric precipitate is a yellowish white, and is re-dissolved by boiling with an excess of hydrodedate; that of silver is of a pale yellow, like silver phosphate, but becomes black in a short time. That of platinum (chloride) is the double chloride of platinum and potassium, and its formation is accompanied by a brisk effervescence. The same phenomenon is still more marked with bismuth nitrate where a white precipitate is deposited. Gold chloride gives no precipitate in the cold, but merely a faint brown colouration. On ebullition gold separates out, and the liquid takes a pale violet colouration. Chrome-alum, ammoniacal or potassic, gives a deposit which easily re-dissolves if the chrome is in excess.

Researches on Nitrification by Organic Ferments.—Th. Schlœsing and A. Muntz.—Those vegetable organisms, moulds, and mycoderms which effect so energetically the combustion of organic matter, do not produce nitrification; on the contrary, they transform nitric acid at their disposal at first into organic matter, and then, in part at least, into free nitrogen, the latter phenomenon being often attended with the production of ammonia. They effect, consequently a loss of the combined oxygen existing on the surface of the globe.

Moniteur Scientifique.
March, 1878.

This issue, strange to say, contains no original chemical matter.

April, 1878.

Use of Ammonium Sulphocyanide in Volumetric Analysis.—J. Volhard.—Already reproduced in the CHEMICAL NEWS.

Volumetric Analysis of Phenol.—Dr. W. F. Koppeshega.—The process at present employed for the determination of phenol in creosotic coal-tar oils consists in agitating for some time a known volume in a graduated tube, with a strong solution of caustic potassa, and reading off the volume of hydrocarbides which is gradually deposited. But the decrease of volume is not

a certain indication of the quantity of phenol present. The author has, therefore, devised the following method. The requisites are (1) a solution of sodium hyposulphite, which, in equal volumes, corresponds to a solution of iodine, containing 5 grms. per litre. (2.) A filtered solution of starch. (3.) Bromine-water, of such a strength that 50 c.c., after decomposition by the iodide of potassium solution, require 18—20 c.c. of the solution of sodium hyposulphite. It is preserved in well stoppered bottles, containing at least 500—600 c.c. (4.) A solution of potassium iodide, 125 grms. per litre. A clear solution of the sample of phenol or creosote oil is made by dissolving 4 grms., and making the solution up to 1000 c.c. Of this solution 25 c.c. are transferred, by means of a pipette, into a well-stoppered half-litre flask, which is then rapidly filled up to the mark with bromine-water, stoppered, and shaken for some time. Before adding the bromine-water, however, 50 c.c. of it are conveyed, by means of a pipette, into a beaker, containing 5 c.c. of the solution of iodide of potassium No. 4. After a quarter of an hour the flask is emptied into a large beaker, containing 10 c.c. of the solution of potassium iodide, and the flask is then twice rinsed with water into the beaker. Finally the iodine is determined separately in each goblet, by means of the solution of sodium hyposulphite No 1. The starch water is only added at the end of the operation. The result is read off when the blue colouration no longer reappears after standing for some minutes. If we have used in the determination 25 c.c. of the solution of phenol, containing 0·1 grm. of the sample, adding 475 c.c. of bromine water, and using 50 c.c. for the titration of the bromine water, and determining the quantities of iodine set free by means of the standard sodium hyposulphite No. 1, the calculation will be much simplified by the use of the formula $(9{\cdot}5\ a - b)\ 0{\cdot}61753$; a represents the number of c.c. of the solution of sodium hyposulphite used for determining the strength of the bromine water, and b the number of c.c. which correspond to the excess of bromine in the experiment. The number found shows the percentage of phenol in the sample examined.—*Zeitschrift f. Analyt. Chemie.*

Researches on the Aromatic Amines. — MM. Noelting and Boasson. — An examination of dimethyl-paratoluidin, and dimethyl-orthotoluidin. The authors have found, that in the dry distillation of rosanilin, the oils passing over below 220° contain a small quantity of a secondary base, doubtless a mixture of mono-methyl-anilin and toluidin, in consequence of the formation of nitrosamin.

Blue Alizarin.—M. Prud'homme laid before the Société Industrielle de Mulhouse samples of goods dyed and printed with a new product lately offered in the market by the Ludwigshafen Alizarin Works, under the name of "Blue Alizarin." This colour was discovered by M. Prud'homme among the derivatives of monitro-alizarin, but was first isolated and obtained on a commercial scale by M. Brunck. It sublimes in black crystals like those of indigo, giving off violet-red vapours. It is almost insoluble in water, sparingly soluble in alcohol, but more readily soluble in acetic acid. In alkalies it dissolves with a blue colour. Its barytic and calcic salts are a greenish blue. Concentrated acids dissolve it with a fine red colour. Blue alizarin does not dye below 70°, and the process should be pushed to a boil, and is facilitated by adding to the bath either a little soap, or oil such as is used in dyeing Turkey reds. The shades produced with the different mordants are; with alumina, a violet-blue; iron, a greenish blue, chrome, a violet; and tin, a reddish violet. The most useful mordants in printing are ammonium, or potassium ferrocyanide, and chromium acetate. By steaming, a colour of one part alizarin blue with four of thickening yields shades like deep indigo blues, and as with red alizarin the shades are brighter, and fuller upon cloth prepared as for Turkey reds. Goods dyed or printed with alizarin blue resist soap, dilute acids, chlorine, and light very satisfactorily. Wool can be dyed without mordant in an acid bath. One of the most interesting peculiarities of blue alizarin, pointed out by M. Prud'homme, is that it becomes soluble in an alkaline solution, being reduced like indigo. The vat is rose-coloured, and is covered with a greenish-blue scum. Being almost insoluble in water, it is fixed on the fibre as it becomes re-oxidised by the air, and produces blue shades like those of indigo.

Extraction of the Metals Accompanying Platinum at the Gold and Silver Refinery, at Frankfort-on-the-Main.—L. Opificius.—Not suitable for abstraction.

Biedermann's Central-blatt,
Heft 1, January, 1878.

Formation of Hail.—Prof. H. Fritz.—The author assumes that the clouds and watery vapours rise upwards into colder regions, so that the hail granules thus formed descend from a great height, and further, that vesicles or globules of water exist in the atmosphere in a super-refrigerated state.

Influence of "Leaf-wood" in Comparison with Conifers upon the Rain and the Quantity of Moisture in the Air.*—M. Fautrat.—Pine-trees seem to have the greatest efficacy in increasing atmospheric moisture. They retain more than half the rain-fall upon their heads, whilst broad-leaved trees transmit 58 per cent of the atmospheric moisture to the ground. Hence pine-forests lessen the danger of flooding in rivers, which have their source in mountains so planted.

Proportion of Carbonic Acid in the Ground-Air.—P. Smolensky.—The author, from experiments on the air of soils from cemeteries and districts abounding in cesspools, finds that the carbonic acid in such air shows a distinct relation to the pollution of the earth.

Absorption of Bases by the Soil.—H. P. Armsby.—The absorption of combined bases by the soil consists in an exchange of base between the salt employed and the hydrated silicates of the soil. This exchange is, however, only partial, and varies with the concentration of the solution and with the proportion between the volume of the solution and the quantity of soil used.

Analysis of Soils.—Ad. Mayer. — The author concludes that the determination of phosphoric acid alone gives a good clue to the quality of a soil. If an unfruitful soil contains a fair proportion of phosphoric acid, the cause of its barrenness is probably not the absence of plant-food, but the presence of some positive but less easily detected cause of infertility.

"Beet-root Sickness in Solids."—Prof. J. Fühling.—The incapacity of certain soils to yield good crops of beet-root is ascribed by the author primarily to the exhaustion of the potash, and secondariiy to the exhaustion of phosphoric acid.

Action of Nitrogen as Ammonia and as Nitric Acid upon the Crops.—W. Lott and Dr. J. König.—A better crop of rye was obtained by the application of plain superphosphate in autumn, followed by nitrate of soda in spring, than by the use of an ammoniacal superphosphate in autumn.

Manurial Experiments upon Flax.—A. Renouard.—Flax may be more frequently introduced into agricultural rotation without exhausting the soil, if G. Ville's special manure is employed, consisting of 400 kilos. superphosphate, 200 kilos. nitrate of potash, and 400 kilos. gypsum per hectare.

Injury Done to Forests by Sulphurous Acid.—Dr. J. König.—Trees exposed to the fumes of vitriol works, &c., absorb sulphurous acid by means of their leaves, and

* The Germans apply the term "leaf-wood" to all other trees in contrast with the conifers, which they designate "needle-wood."

are found to contain an abnormal amount of sulphates. Water holding sulphate of zinc in solution extinguishes vegetation wherever it penetrates, the so-called "zinc-violet" forming the sole exception.

A lulteration of Soap.—The following receipt is extracted by *Dingler's Pol. Journal*, from the *New Soap-boiler's Journal* (Neue Seifensiederzeitung):—"Saponify 600 kilos. cotton-seed oil, 200 kilos. tallow, and 200 kilos. bone-oil, with potash-lye at 18° in the usual manner. A thick mixture is then made of solution of potash, potato-flour, and soluble silicate of soda, and two parts of soap are crutched thoroughly up with one part of this mixture, boiled, and mixed with more soda-lye till the total weight rises to more than double that of the fatty matter originally present." *Dingler's Journal* remarks that when trade-organs thus openly recommend sophistication caution is needful on the part of purchasers.

Gazzetta Chimica Italiana.
Fasc. i., 1878.

Formation of the Corresponding Alcohols in the Preparation of Aldehyds on Piria's Method.—Stefano Pagliani.—We may conclude that in the dry distillation of a mixture of a formiate, and of the salt of a fatty acid, there are formed, as necessary products, the aldehyd, and the corresponding alcohol, and that all the hydrogen necessary for the hydrogenisation of the aldehyd is furnished by the formiate.

Researches and Considerations on the Glucosidic Nature of the Natural Tannin of Gall-nuts, and on a Crystalline Substance Obtained by the Action of Arsenic Acid upon Gallic Acid.—Dr. Pasquale Freda.—The author finds that Strecker's equation cannot express the transformation of natural tannin. The substance obtained by the action of arsenic acid cannot be digallic acid. It is very soluble in water, the solution having an acid reaction. If treated with ferric chloride, the solution gives a blue-black precipitate; it precipitates also the solution of isinglass. The dry substance is soluble in ethylic alcohol, absolute or dilute, in ether, in a mixture of alcohol and ether, in methylic and amylic alcohol, in glycerin, potassa, and ammonia, to which two latter liquids it imparts a cinnamon colour. It is insoluble in carbon bisulphide, in oil of turpentine, in benzol, toluol, xylol, chloroform, sulphuric and hydrochloric acids. Its melting-point is constant at 210°.

An Experiment on the Means of Rapidly Evaporating a Large Quantity of Liquid.—J. Brugnatelli.—The author finds that the escape of steam from water boiling in a flask is much increased if there is an open tubulure in the side of the vessel above the surface of the liquid.

MISCELLANEOUS.

Russian Scientific News.—M. Setchenoff has found that the white of eggs, on being boiled in vacuum, turns solid as fibrin. In order to ascertain if the yellow of eggs has some influence on this reaction, experiments were made, and it was found that when a small quantity of the yellow is admixed, the solidification of the albumin, as mentioned above, is five times quicker. This fact, besides being a matter of great importance for physiology, allows us to obtain the albumin in a more pure form.

M. Eremin has made experiments with ozone. He found that in oxalic acid solutions ozone may be preserved longer than while using other fluids for this purpose. Another fact is very remarkable: the decomposition of ozone in sunlight is slower than in the dark; also, ozone which, after preparation, was left for some time, and was not immediately used, had a more energetic action for disinfecting purposes.

S. Kern, M.E.

St. Petersburg.

NOTES AND QUERIES.

Moulding Wax.—Can any of your readers inform me how wax is prepared for moulding and modelling? I have worked up bees'-wax with oil and Venice turpentine, but it sticks to the tool, and is not quite tough enough.—Amateur.

MEETINGS FOR THE WEEK.

Tuesday 21st.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Royal Institution, 3. "On Some Points in Vegetable Morphology," W. T. Thiselton Dyer, M.A.
Wednesday, 22nd.—Society of Arts, 8.
—— Geological, 8
Thursday, 23rd.—Royal 8.30.
—— Royal Institution, 3. "On Colour," Lord Rayleigh, M.A.
Friday, 24th.—Royal Institution, 8, Weekly Meeting. "Geology of Gibraltar, and the Opposite Coast of Africa," Prof. Ramsay, 9.
—— Quekett Club, 8.
Saturday, 25th.—Royal Institution, 3. "On Richard Steele," Prof. Henry Morley.
—— Physical, 3.

TO CORRESPONDENTS.

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T. H. Walker.—Apply to the Secretary, Burlington House, Piccadilly, W.

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THE CHEMICAL NEWS.

Vol. XXXVII. No. 965.

SULPHATE OF SODA.*

By JOHN AFFLECK, M.A., D.Sc.

(Continued from p. 171.)

Since Messrs. Jones and Walsh introduced their mechanical decomposing furnace some eighteen months ago, a rather lively interest has been manifested in this department of the process. A number of our leading chemical manufacturers lost no time in proceeding to Middlesbrough to see for themselves the new wonder which had arisen in the east. A short inspection seems to have sufficed to convince most of them that the thing was as good as it was represented; in fact, that the new furnace was in every respect a perfect success, and would prove a valuable acquisition to the trade. The glowing accounts of its capabilities which they brought back to their brethren on the Tyne, led to a paper being read on the subject before the Newcastle Chemical Society by Mr. Clapham. In the discussion which followed the reading of this paper the main difficulties and weak points of the new invention were either completely ignored, or tackled with but little spirit, by the manufacturers present. Some doubts were, indeed, timidly expressed as to the furnace being so admirably adapted as was stated, for giving easy and perfect condensation. But on every other point criticism seems to have been disarmed. Each succeeding speaker rose to still higher encomiums, and all was *couleur de rose*. In short, before separating, they had got up the weekly production to, at least, 100 to 120 tons, with no appreciable wear and tear of any part—no nuisance from gas escapes or "green" batches—great saving in sulphuric acid—a perfect condensation of the hydrochloric acid—fuel, a mere trifle—wages, not worth mentioning. The next step was a rush to have the first Jones' furnace built and working on the Tyne, each manufacturer making a few modifications or prospective improvements on the original to suit his own fancy. But a few weeks' trial was quite sufficient to show that the expectations that had been raised regarding the performance of this furnace were most extravagant, and doomed to bitter disappointment. And then some of its quondam panegyrists did not hesitate to run to the other extreme, and declare the whole thing a miserable failure. This by no means accords with the view I have taken of the case. It must be admitted, I think, on the one hand, that the machine invented and patented by Messrs. Jones and Walsh for performing this step in the alkali process—a step involving the most severe and the most disagreeable sort of manual labour—is far from being all that could be desired; and also that the actual results obtained in working it on the Tyne have been, in nearly every case, most disappointing hitherto. But, on the other hand, we are bound to acknowledge that, while previously only a few feeble and spasmodic attempts had been made at rare intervals to invent a machine for this purpose, Messrs. Jones and Walsh have earned the distinction of being the first to produce one that, with all its defects, is undoubtedly able to do the sort of work required in a very superior manner, and more economically than it could be done hitherto by hand-worked furnaces.

Some eight of these furnaces have been built on the Tyne, nearly all on different plans; and it is no doubt true, as the patentees aver, that the irregularities in working, frequent break-downs, and small outputs of most of these furnaces have been, in some degree at least, due to this fact, that manufacturers would insist upon making various alterations in the original plan before they had the slightest experience to help them to do so judiciously. Only *two* firms, so far as I know, have hitherto succeeded in getting anything like regular working, or an output approaching to what was anticipated from these furnaces. I mean the St. Bede Chemical Company, at East Jarrow, and Messrs. Muspratt, Bros., and Huntley, at Flint. In these cases, I understand, about 70 tons per week of sulphate of soda has been got with some degree of regularity. All the rest, at least on the Tyne, have led a very chequered and precarious existence, rarely able to keep going for many weeks, or even days together, without some more or less serious break-down of the machinery; and when fortune was propitious, and they got a clear week's run, turning out only 30 tons to 40 tons of sulphate. Though many stoppages have been caused by fractures of various parts of the driving gear, the most serious and discouraging ones have been due to such causes as snapping of main vertical shaft or cross arms inside the furnace, cracks in the pan segments, and leakages of acid through them, or over the edges, or through the bottom joints. Some pronounce the burning down or breaking of the arms the greatest drawback of the furnace. Others, who have taken more precautions against that, find the leakage through the bottom joints an almost insurmountable difficulty. Of the eight furnaces that were built on the Tyne, I understand that three have been already worn out and abandoned. One of these, however, namely that at Messrs. Imeary's Works, Heworth Shore, has been replaced by one built and worked by the patentees themselves. This latter has now been working very satisfactorily for three or four months without a stoppage or hitch of any sort, giving a steady output of about 7 tons of sulphate in the twenty-four hours, and taking a charge of 4½ tons to 5 tons of salt at a time. In this furnace, the patentees have introduced peculiar box and expansion joints, covering the ordinary joints of the bottom segments as an additional precaution against leakage. I believe they have had the desired effect. Another of the eight furnaces has never been started at all; while the remaining four are working with more or less success and regularity, turning out from 40 tons to 70 tons per week.

Messrs. Black and Hill have recently patented a modification of the Jones's Decomposing Furnace, the apparatus for which is at present being erected at the St. Bede Works, and will be ready to start work very soon. It consists in adding to the Jones's pan a large solid metal pot to receive the batch of salt and acid in the first instance, and prepare it for the subsequent roasting and finishing operation to be carried out in the Jones's furnace; it fact, to bear the same relation to it as the pot does to the roasting bed of the ordinary hand furnace. This pot is to be about 12 feet long, 6 feet broad, and 4 feet to 5 feet deep, covered by a brick arch, and fired from below as usual. The mixture of salt and acid is to be worked mechanically by paddles fixed on a horizontal arm, caused to rotate near the bottom by spur gearing; and, when properly stiffened, it is to be discharged by the same means through an opening, closed by a sliding door, into the mechanical roaster. Waste heat of pot and roaster are both to be utilised in drying and heating up salt and acid previous to being charged. I hope Mr. Hill will give us some account of the working with this new arrangement of plant.

It seems, at first sight, that to give up in this way the principle of performing the whole operation in one vessel, and to add another heavy metal vessel and more machinery to that already required for the single Jones's pan is going in the wrong direction, and that, by complicating the operation, it will be sure to render it more expensive. but, on the other hand, it may be urged that by dividing the operation into two stages, as in the ordinary hand furnaces, the following advantages will be gained:—

* Inaugural Address to the Tyne Chemical Society, delivered October 12, 1877.

(1.) A greater output of sulphate in proportion to the capital expenditure on the plant employed.

(2.) A saving of fuel, by effecting the evaporation of the water and the bulk of the decomposition by bottom heat.

(3.) A saving of acid, by withdrawing the greater portion of it from the action of the fire.

(4.) Easier and better condensation, by employing a close pot, thus obviating one of the chief objections to the ordinary Jones furnace.

(5.) Doing away with the difficulty of keeping the joints of the Jones's pan tight enough to hold in acid, and rendering it less liable to damage by cracking than in the present method of working, where large quantities of cold salt are suddenly dropped upon the highly heated bottom.

The short experience we have already had of these mechanical furnaces may, I think, justify the following general conclusions:—

(1.) The production of salt-cake by mechanical decomposition of salt is now an accomplished fact, practicable on the large scale.

(2.) It is probable that the operation will be more regularly and also more economically conducted in two separate furnaces—a close pot and open roaster.

(3.) The present Jones's furnace effects with difficulty and with an undue expenditure of time and fuel the decomposition of the last portions of salt and bisulphate. To render the decomposition complete in a reasonable time, the temperature requires to be raised too high for the safety of the machinery as at present constructed.

(4.) A revolving furnace, like the Mactear carbonator, will most probably effect the second part of the operation more rapidly and with less fuel, by exposing the charge more uniformly to the action of the fire; and, at the same time, with less danger of burning down the internal working gear.

(5.) The mechanical furnace will effect a saving in the cost of labour, to the extent of at least one-half, or probably more, over the hand furnace.

(6.) The saving in fuel claimed by the patentees for the Jones furnace has not hitherto been clearly established.

(7.) A considerable saving in sulphuric acid is already shown, and will be still greater if the close pot is adopted. In the old way of working on the Tyne, with open roasters, 5 per cent to 7 per cent, at least, of the acid run into the pot is volatilised by the very imperfect turning over of the charge in the roasting bed, and the consequent over-heating of portions of it before the decomposition of the whole is sufficiently advanced. By the mechanical furnace this loss should be reduced to 1 per cent, or 2 per cent at most.

(8.) The lasting power of all the furnaces hitherto built on the Tyne is very doubtful. Wear and tear is very heavy if the furnaces are pressed to a full red heat. All the details of the construction clearly require a great deal of revision before attaining the form that, for least outlay, will work and heat the materials most economically, while exposing its own working parts to the least action of the fire.

(9.) The quality and amount of the condensation from these furnaces has not yet been satisfactorily shown. A longer experience of their action and more careful observations are needed to enable us to judge how far the more gradual evolution of the gas, said to take place, counterbalances the disadvantage of the open pan for condensation.

(10.) In working mechanical decomposers, whether close or open, there will be a great advantage in using the strongest sulphuric acid possible, in order to minimise the loss of acid in the evaporation of the water. This will necessitate greater attention being paid to prevent radiation of heat from pyrites burners, in order to obtain the full concentrating effect of the hot gases in the Glover towers.

Another very remarkable salt decomposing machine has recently been patented by Messrs. Cammack and Walker, of St. Helens. This aims at making the process a perfectly continuous and automatic one, the machine being constructed to feed the salt and acid into the furnace at one end in a constant stream, to work them as they pass through, and finally to deliver them at the other end in the shape of finished salt cake. This is the perfect "beau ideal" of a decomposing furnace. But, unfortunately, the mechanical difficulties to be overcome in attempting to carry out in practice such an idea are great in proportion to the ambitiousness of the attempt.

The arrangement consists of a metal cylinder, about 20 feet long and 3 feet or 4 feet in diameter, carried horizontally by friction rollers at each end, caused to revolve by suitable spur gearing, and enclosed for the most part in a square fire-brick furnace, which effects the heating of the charge from the outside. The ends of the cylinder are closed by metal plates, which are fixtures, and bear flanges, within which the cylinder freely revolves. At the end farthest from the fire is the salt hopper, from the bottom of which a straight metal pipe passes through the end plate into the cylinder. An endless screw, working in this pipe, and driven by a belt off the main driving shaft, carries the salt continuously into the furnace; while the acid arrives by a small lead pipe debouching immediately behind the screw, and gets thoroughly mixed with the salt before entering the cylinder. Two shafts pass through the cylinder parallel to its axis. One is fixed, provided with teeth to scrape the sides, and prevent the materials adhering in caked masses. The other is made to rotate in the opposite direction to the cylinder, by means of another sheave driven off the main shaft. This movable shaft carries "pitched" teeth or stirrers to stir up and mix the materials, and move them regularly forward towards the delivery end next the fire. The gas evolved is conducted by a pipe leading out of the feed end into a series of 12" vertical glass pipes, where it is condensed by spray jets. Being practically pure hydrochloric acid entirely free from all products of combustion and atmospheric air, 56 feet of such pipes have been found quite sufficient for total condensation.

Till very lately, this furnace has only been tried at the Marsh Alkali Works, Widnes. There it was abandoned after a short trial, as I have been informed by Messrs. Golding and Davis, on account of the mechanical difficulties connected with it. The chief of these they found to be the "sagging" of the two long horizontal shafts passing through the cylinder, under the action of the heat; it being impossible to get any centre bearings for them. This resulted in the blades or scrapers not doing their work properly, so that the salt cake accumulated on the sides was not uniformly pushed forward, and choked up the cylinder.

Quite recently, I understand, Messrs. Gaskell, Deacon, and Co., of Widnes, have taken up this furnace as peculiarly suitable for their chlorine process. They have now one at work; so that we may expect soon to see how far the mechanical difficulties of the continuous decomposing furnace may be overcome by the aid of skill and capital.

Before proceeding to the consideration of the *direct* process for manufacturing sulphate of soda, permit me to say a few words on one point connected with the old decomposing plant. You are aware that several objections are taken to the "close roasters" so invariably used in the Lancashire district. Of these, not the least important, is that founded on the loss of work, expense of repairs, and gas nuisances caused by the frequent leakage of HCl into the smoke flues through cracks in the inner arch, or in the working bed. Now this objection seems to be in a great measure obviated by the gas-fired furnaces introduced, some years ago, by Mr. Gamble, at St. Helens. Heating in this way, the pressure in the combustion flues can easily be kept greater than, or at least equal to, that of the working bed, so as to prevent gas from passing through cracks or fissures from the latter into the former. If any mixing of the two currents of gas should take place owing to defects in the brick-work of arch or bed, smoke will

pass from the fire flues into the roasting bed, not HCl into the fire flues, and thence escape to the chimney. Hence, with such furnaces, very little attention need be given to the state of the inner arch. In fact, I was told that at Messrs. Gamble's they often go on working a furnace for weeks, with a brick or two dropped out of it.

It seems to me rather strange that both gas producers and close roasters should still find no support on the Tyne.

I may also mention that the Messrs. Deacon, at Widnes, are now aiming at producing the same effect in the fire flues as I have described, without using gas, by sinking the fire-place some 7 feet or 8 feet below the working bed. This plan, however, will cause a good deal of inconvenience, and extra labour in firing.

(To be continued.)

A STUDY OF PLAT-AMMONIA COMPOUNDS.

By SAMUEL E. PHILLIPS.

SOME thirty years ago Laurent and Gerhardt sought to explain the salts obtained by Magnus, Gros, Raewsky, Reiset, and others, by supposing two platinums of mono- and diatomic weight, calling the former platinicum and the latter platinosum. An attentive study of the real chemism of those researches then revealed the simple and welcome fact that one equivalent weight of platinum was alone sufficient, with the ordinary condensations of ammonias, varied with certain *forced* reactions by which binoxide, bichloride, and oxychloride bases were produced.

In 1870 Prof. Odling gave a studied outline of those compounds, adopting somewhat of the ideas and nomenclature of those great men whose talent and audacity have exerted so great an influence on chemical philosophy to this day. He has one double equivalent or diatomic weight of platinum, which, however, does double duty, replacing either two or four equivalents of hydrogen, and the following groups are curiously equivalent or replace each other:—

$$2HCl = 2HCl.$$
$$2H(HO) = 4HO.$$
$$2H(NO_3) = 2HO.NO_5.$$

Taking the chlorides as typical of their series, they have some curious ratios:—

I. The platosamines—
$$Pt''(H_2N)_2.2HCl = H_6N_2.2HCl = H_8N_2,Cl_2.$$

II. The amo-platosamines—
$$Pt''(H_5N)_2.2HCl = H_{12}N_4.2HCl.$$

III. The platinamines—
$$Cl_2Pt''''(H_2N)_2.2HCl = H_{10}N_2.2HCl.$$

IV. The amo-platinamines—
$$Cl_2Pt''''(H_5N_2)_2.2HCl = H_{16}N_4.2HCl.$$

V. The amo-di-platinamines—
$$Cl_2OPt''''(H_5N_2)_4.4HCl = H_{32}N_8.4HCl.$$

In III. Cl_2 is replaced by $(HO_2)_2$ and (NO_6).
In IV. Cl_2 „ „ $(NO_4)_2$.
In V. Cl_2 „ „ $(NO_6)_2$!

These numerical anomalies have not passed unnoticed by the great intellects devoted to a continuation of this wanton system of guessing and hypothesis, where the simple chemism of the subject is so fatally obliterated. (For a comparative analysis of the Odling outline see CHEMICAL NEWS, vol. xxii., p. 49.)

For the further ingenuity displayed we can well refer to the latest aspect as given by Watts in the recent edition of Fownes's invaluable epitome of modern chemistry. The same five groups are essentially preserved, and new names and radicals are curiously invented to lessen the anomalies referred to.

Again taking the chlorides as typical of their series we have—

I. Diammonio-platinous compounds—
$$2NH_3Pt''.Cl_2 = H_8N_2.Cl_2.$$

II. Tetra-ammonio-platinous compounds—
$$4NH_3Pt''.Cl_2 = H_{14}N_4.Cl_2.$$

III. Di-ammonio-platinic compounds—
$$2NH_3Pt''''.Cl_4 = H_{10}N_2.Cl_4.$$

IV. Tetra-ammonio-platinic compounds—
$$4NH_3Pt''''.Cl_4 = H_{16}N_4.Cl_4.$$

V. Octaminio-platinic compounds—
$$8NH_3Pt_2.Cl_8 = H_{32}N_8.Cl_8.$$

Taking R to represent Cl or its supposed equivalents, it is curious that all the latter series are given as R_6O_{11}. Excepting II. and III., which are doubly anomalous in their ratios, here is the fashionable mistake of supposing that condensed ammoniums are $n(H_4N)$, and their chloride or acid elements are di, tri, tetra, penta, or octa, as determined by the number of N or analogous equivalents.

To such as can appreciate the overwhelming number of plain facts, I have demonstrated the absurdity of both these hypotheses. A condensed ammonium is in principle and fact precisely what any other condensed radical is, and all are subject to one pervading law, not only in the genetic mechanism of their production, but in the controlling limits of their variations or departures from normality.

In I. and IV. it is alleged that platinum replaces 2H in the former and 4 in the latter, while in III. the bivalent radical, $(Pt''''Cl_2)''$, plays the same part as Pt'' in the first series.

Against this tirade of assumption we have ever reiterated that the metals platinum, gold, copper, iron, and potassium, &c., replace one H with all the certainty of established law, and strange indeed is it that they who deny the free existence of the first and best known radicals should now reveal the secret "hocus pocus" by which, with a practised ingenuity, any number of radicals, with any required valency, can be manufactured *on paper!*

The Pt molecule generally has two affinities, hooks, or points of attachment, and when required we can draw it with four such attractive appendages, and after hanging chlorine on two of these hooks, we then have two free affinities, and therefore a bivalent radical ($Pt''''Cl_2$)!

A Nero fiddling over a Rome in flames can scarcely be more reprehensible than such trifling as this in presence of the increasing demand for the bread of knowledge. We now give a list of these compounds, eschewing hypothesis as much as possible, and reducing all alike to their lowest or simplest atomic quanities:—

I. $2NH_3Pt''.Cl_2 =$

The chloride	..	PtH_3N,Cl or $PtH_6N_2,Cl.PtCl.$
The oxide	.. ..	$PtH_3N,O.$
The hydrate	.. ..	$PtH_3N,O.HO.$
The sulphate	.. ..	$PtH_3N,O.SO_3.$
The platinate	..	$PtH_3N,Cl.PtCl_2$, &c.

II. $4NH_3Pt''.Cl_2 =$

The chloride	.. ..	PtH_6N_2,Cl or $PtH_{12}N_4,Cl.PtCl.$
The oxide	.. ..	$PtH_6N_2,O.$
The hydrate	.. ..	$PtH_6N_2,O.HO.$
The carbonate	..	$PtH_6N_2,O.CO_2.$
The platinate	..	$PtH_6N_2,Cl.PtCl_2$, &c.

III. $2NH_3Pt''''.Cl_4 =$

The chloride	.. ..	PtH_3N,Cl_2 or $PtH_6N_2,Cl_2.PtCl_2.$
The oxide	.. ..	$PtH_3N,O_2.$
The sulphate	.. ..	$PtH_3N,O_2.SO_3.$
Another	.. .. ..	$PtH_3N,O_2.2SO_3.$
A nitrate	.. ..	$PtH_3N,O_2.NO_5$ (*a*).
The nitrate	.. ..	$PtH_3N.O_8.2NO_5$ (*b*), &c.

IV. $4NH_3Pt''''.Cl_4$ =

The chloride.. ..	PtH_6N_2,Cl_2 or $PtH_{12}N_4,Cl_2.PtCl_2$.
The oxide	PtH_6N_2,O_2.
The nitrate	$PtH_6N_2,O_2.NO_5$.
The oxalate	$PtH_6N_2,O_2.C_2O_3$.
The platinate ..	$PtH_6N_2,Cl_2.PtCl_2$, &c.

V. $8NH_3Pt_2''''.Cl_6O_{11}$.

The oxychloride ..	PtH_6N_2,Cl_2 or $PtH_{12}N_4.OCl.PtCl_2$
,, ,, ..	$PtH_6N_2.OCl$.
&c.	&c.

In addition to the reservations and statements made (vol. xxii., p. 49) we now offer a few brief remarks on these series.

There are strong reasons why the platosamines should be regarded as mono rather than diamines. First, that as alleged, they *all* have two atoms of acid, and the elements of two atoms of base, in such way as is quite incompatible with a true diamine. Secondly, that no evidence has been afforded of their diamine character. On the contrary, the "amo-platosamines" have the elements of two diamines, fully borne out by the conditions specified in their production. The hydrate of the former is a strong base with alkaline reaction, absorbing carbonic acid from the air, and liberating ammonia from its salts. The oxide is obtained by heating the hydrate to 110°. The bromide and iodide of the second series are obtained from the sulphate with bromide and iodide of Ba, and they crystallise in cubes. The oxide is a crystalline mass, strongly caustic, and alkaline like potash. It forms two carbonates, an acid and a neutral salt, and the sulphate and nitrate are good crystalline salts.*

III. *Of the Platinamines (Gerhardt).*

The chloride is produced by passing chlorine into a boiling solution of the first chloride (I.), and what more simple or likely could be the reault? But the strong argument chiefly lies in the diminished basic characters of all such dioxy- or dichloro-derivatives.

"An oxy-nitrate," $N_2H_6Pt''''(NO_3)_2O''$ (*a*), is obtained by boiling the chloride for several hours with solution of silver nitrate, "a yellow crystalline powder," sparingly soluble.

"The normal nitrate" (*b*) is specially interesting as illustrating a feature which otherwise is strangely omitted in Watts's recent outline; but the fact is patent to all who can observe widely and apart from hypothesis that where proto-bases are inclined to a non-acid behaviour di-bases are disposed to take up two atoms of acid. And in this respect the older lists are fuller and more instructive than the new, as having less of hypothesis and numerical distortion. It is also worth notice that upon the modern or doubled view my nitrates and di-nitrates would be di and tetra, which is most unlikely; and if my ammonium ratios be true and valid all the binoxide and bichloride salts would become tetra-oxide and tetra-chloride bases, which is intensely absurd.

IV. *Of the Gros Series.*

The chloride here is produced precisely by the same forced chlorination as the former, that on I., this on the chloride II. The oxide of this series has not been isolated, and when treated with silver nitrate the chloride easily gives up its extra atom of chlorine. The chloro-bromide has been prepared, and several similar salts:—

"A nitrato-chloride"	$PtH_6N_2,OCl.NO_5$ (*a*)
"A sulphato-chloride"	$PtH_6N_2,OCl.SO_3$
"An oxalo-chloride"	$PtH_6N_2,OCl.C_2O_3$
"The oxy-nitrate"	$PtH_6N_2,O_2.NO_5$ (*b*)

V. *Of the Raewsky Salts.*

The typical chloride is probably, or at any rate contains, the elements of chloroplatinate of a tetra-ammonium with an oxychloride base. But even this admits of an isomeric alternative, and these salts generally are, in all probability, feeble di-combinations of the previous series. "The oxy-nitrate is otherwise called "an oxy-nitrate or basic nitrate, which we regard as a sesqui-nitrate—

$$2(PtH_6N_2,O_2).3NO_5.$$

But why a larger proportion of acid should lead to such a name is one of the curiosities of nomenclature. A "nitrato-oxychloride" contains the elements of—

$$\left.\begin{matrix} PtH_6N_2O_2.NO_5 \\ PtH_6N_2OCl.NO_5 \end{matrix}\right\} = (a) \text{ and } (b).$$

It was obtained by boiling the chloride I. with large excess of nitric acid, and similar salts have been obtained with carbonic and oxalic acid,—

$$\text{The carbonate} \left\{\begin{matrix} PtH_6N_2O_2.CO_2 \\ PtH_6N_2OCl.CO_2 \end{matrix}\right.$$

$$\text{The oxalate} \left\{\begin{matrix} PtH_6N_2O_2.C_2O_3 \\ PtH_6N_2OCl.C_2O_3 \end{matrix}\right.$$

And a—

$$\text{"Basic-oxalo-nitrate"} \left\{\begin{matrix} PtH_6N_2O_2.2C_2O_3 \\ PtH_6N_2OCl.NO_5 \end{matrix}\right.$$

Old chemists used to think that two atoms of acid made an acid salt, but the reverse is only one of the vagaries of modern chemistry. It is severely tasking our feeble evolution of the simple principles of mineral chemistry to unwillingly force us into a region of slende affinities, such as abounds in mineralogical complexities but the effect can only be to exalt our conception of the great predominance of electro law, extending so far as it does towards the region where all types and ratios are lost in mere mechanical admixture.

Again referring to the first chloride (I.) with its isomers, the same peculiarities have been observed with the corresponding palladium chlorides, and Hugo Müller offers an explanation of the red and yellow isomers. He regard the red as palladium ammonium chloride, $2NH_3.PdCl_2$ the yellow as palladiammonium chloride, $N_2H_6.PdCl_2$ Now in sight of the permutations of a few integers, is it cause for gratulation that such a play upon names and atoms can be regarded as satisfactory? Why not invert the names and types, and why should either be a true representation? The yellow body is seen in its decided basic history. "It gives an oxide which is a strong base, soluble in water, with strong alkaline taste and reaction, absorbing CO_2 from the air, &c. Hence our estimate as PdH_3N,Cl. It also gives $[N_2H_4Pd''(NH_4)_2]Cl_2$ = PdH_6N_2,Cl, and many other salts of both the mono- and diamine series. It is not for me to say what the red isomer may be, as in the Pt analogue there are three isomers, but it is easy to foresee that they may be polymers or chlorhydrates, which may admit of easy identification.

If Pt be *bivalent* in series I. and II., and *quadrivalent* in III. and IV., between which I see no difference whatever as affecting the Pt element, it is curious to divine what may be the explanation of some future time, when monad and triad replacements of H are seen to evince the same behaviour.

It is already quite clear that sulphates of ethylen and platinous diamines are isomorphous, and that between the replacements of gold, ethyl, and potassium there no essential difference of type:—

AuH_3N,Cl	AuH_6N_2,Cl
PtH_3N,Cl	PtH_6N_2,Cl
$(C_4H_3)H_3N,Cl$	$(C_4H_3)H_6N_2,Cl$
$(C_4H_5)H_3N,Cl$	$(C_4H_5)H_6N_2,Cl$

Let ethylen or some negative amine or diamine be treated as the corresponding Pt amines have been, and who can doubt the certainty of the corresponding character and typical results?

In another short paper we propose to entertain three inferential aspects arising out of this research, which may be considered of great interest to such as look forward to a simpler and brighter chemical philosophy.

* It may also be observed that in many cases these salts give off ammonia with a reversion to series I.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 16, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the confirmation of minutes, &c., the following certificates were read for the first time:—W. R. Crisper and C. T. Macadam. The following gentlemen were elected Fellows of the Society:—J. W. Knights, J. H. Wilson, H. R. Smith, G. A. George, F. Slinger, W. Jago, H. W. Jones, A. E. Tucker, B. Gregory.

The first paper was read by the SECRETARY, "*On the Detection and Estimation of Free Mineral Acids in Various Commercial Products*," by PETER SPENCE and A. ESILMAN. The method is based on the fact that peracetate of iron even in dilute solutions has a distinct yellow colour, not perceptibly altered by acetic acid or solutions of persulphates, but instantly bleached by free sulphuric, hydrochloric, and nitric acids. The solution is made by dissolving 10 parts of iron alum and 8 parts of crystallised acetate of soda in 100 parts of a 8 per cent solution of acetic acid (25 per cent). The method is especially suited for alum cake, salt cake, &c. 200 grs. of the sample are triturated in a mortar with 8 per cent solution of acetic acid, and peracetate solution added until the mixture has a decided yellow tint, showing that all the free acid has been neutralised. The liquid is then diluted to 100 measures with the acetic acid water, and a portion filtered into a test-tube. In another test-tube as many measures of the peracetate solution as have been used for the above liquid are diluted up to about 80 measures with the acetic acid water. Standard sulphuric acid is then run in until the colour of the liquid is the same as that of the 100 measures in the first test-tube. The quantity of acid used is the measure of the free acid in the cake.

The second paper was read by the SECRETARY; it was entitled "*The Action of Hypochlorites on Urea*," by H. G. H. FENTON. The author has found that when urea is acted upon by a hypochlorite in the cold in the presence of a caustic alkali only half the nitrogen is evolved. Thus the mean of eighteen experiments gave 18·22 per cent nitrogen, theory requiring 37·3. Several samples of hypochlorite and various specimens of urea were tried, but all gave the same results. If an alkaline carbonate be used in place of a caustic alkali the whole of the nitrogen is evolved. Thus 0·10303 grm. urea gave 35·3 c.c. N when sodium carbonate was present, but only 19·02 in the presence of caustic soda, theory requiring 38·4. The author then made some experiments to find out what became of the remaining half of the nitrogen. He concluded that it was neither present as urea nor as an ammonia salt, but as a cyanate, the reaction being—

$$2N_2H_4CO+3NaClO+2NaHO=2NaCNO+N_2+3NaCl+5H_2O;$$

further experiments completely confirmed this conclusion. The author states that this reaction may throw light on the constitution of urea, and affords an easy method of detecting and approximately estimating urea in the presence of ammonia salts. There is a mean loss of 2½ per cent of N in all hypochlorite reactions with urea, and of about 8 pera cent in hypobromite reactions, with ordinary apparatus.

Dr. RUSSELL said that some experiments which he made with Dr. West confirmed in the main the author's results; he was surprised to hear the large suppression of nitrogen when the action took place in the cold. Hippuric acid when pure gives off no nitrogen; this fact has lately been confirmed by Dr. Gamgee. Ammonia salts give off all but the theoretical yield. Oxamide is by no means completely decomposed.

Dr. ARMSTRONG pointed out that the above results seemed to favour the constitutional formula of urea suggested by Gamgee and Wanklyn,—

$$C\begin{cases}NH_2\\NH\\OH\end{cases}$$

It must be recollected, on the other hand, that oxamide does not give off all its nitrogen.

Prof. FOSTER said that he could confirm Dr. Russell's statement as regards oxamide, which gives off only about three-quarters of its total nitrogen. He called attention to the importance of using hypobromite solution quite freshly prepared.

The next paper was read by the SECRETARY, "*On the Behaviour of Metallic Solutions with Filter-paper, and on the Detection of Cadmium*," by T. BAYLEY. The author found by quantitative experiments that filter-paper has the power of withdrawing silver salts from solution. Some experiments by Mr. Weston prove that the same action takes place between filter-paper and mercury salts. The author then investigated the action which takes place when drops of metallic solutions are placed on filter-paper, the extent to which the solutions spread being tested by the action of sulphuretted hydrogen. In some cases the solution seemed to concentrate itself in the middle of the spot, and in other cases in a ring round the edge of the spot. The degree of dilution, temperature, and the kind of paper used have an important influence on this phenomenon. Thus, a strong solution of cupric sulphate distributes the copper all over the spot; dilute solutions, on the other hand, concentrate the metal in the centre. The salts of silver, lead, and the per-salts of mercury when moderately concentrated give a wide water ring containing no metal; while the salts of copper, nickel, cobalt, and especially cadmium, must be much more dilute to present the same appearance. This property of cadmium to spread itself over the whole drop is so marked that it affords an elegant means of detecting Cd in the presence of metals whose sulphides are black. The diluted solution is dropped upon filter-paper, and the spot allowed to extend as far as possible. On exposure to SH_2 a black patch is formed surrounded by a vivid yellow ring. A solution containing much nickel, cobalt, or iron in presence of copper, &c., may be examined successively with SH_2 and SAm_2. The presence of free acid increases the mobility of copper salts considerably.

The next paper was read by M. M. P. MUIR; it was entitled "*On Essential Oil of Sage*," by S. SIGUIRA and M. M. P. MUIR. The authors refer to a former paper on the same subject (*Phil. Mag.*, Nov., 1877). The sample of oil with which the present experiments were made had been recently distilled at Leipzig, and was obtained from Messrs. Wright, Layman, and Co. The oil consists mainly of two terpenes, an oxidised liquid, and a camphor. The properties of the terpenes and of salviol, as far as these have yet been examined, are as follows:—1. Terpene boils at 152° to 156°; sp. gr. at 15° 0·8435. Refractive index for D-line at 20° = 1·46071. Hence, specific refractive energy = 0·546; specific rotatory power for soda flame = +12·4. 2. Terpene boils at 162° to 167°; sp. gr. at 15° 0·8653; refractive index at 20° for D 1·4658; refractive energy 0·538; specific rotatory power for soda flame +13·4. Salviol boils at 197° to 203°; sp. gr. at 15° 0·934; refractive index for D at 20° 1·4623; refractive energy 0·495; specific rotatory power for soda flame +16·19. The terpene of lower boiling-point yielded acetic and carbonic acids on oxidation. The higher terpene yielded oxalic acid on oxidation with nitric acid. Salviol yielded oxalic acid, carbonic acid, and hydrocyanic acid on oxidation with nitric acid; a small quantity of what was almost certainly camphor was also produced on distilling the product of the action of nitric acid on salviol with water. The action of bromine upon salviol resulted in the formation of an unstable brominated compound and of small traces of camphor. Phosphorous pentoxide con-

verted salviol for the most part into cymene, but a small quantity of a terpene appeared also to be produced. A small quantity of absolutely pure sage oil has been examined by the authors. It consists for the most part of a terpene, boiling at 264° to 270° ($C_{15}H_{24}$); sp. gr. at 0° 0·9198; at 12°, 0·9137; at 24°, 0·9072; and at 41°, 0·8970. 100 m.m. rotated the polarised ray +3·14°. The terpene is of a dark emerald-green colour. The authors are continuing their investigation.

In the discussion which followed Dr. ARMSTRONG stated that he had obtained by the action of bichromate and sulphuric acid on the camphene from American oil a substance which was dextro-rotatory, and resembled ordinary camphor.

The next paper was read by the SECRETARY "*On the Action of Bromine upon Sulphur*," by J. B. HANNAY. On treating ordinary flowers of sulphur with bromine the author found that some of the sulphur remains undissolved; this insoluble residue was found to consist entirely of prismatic sulphur, and amounted to 0·08 per cent of the sulphur used. Carbon disulphide leaves about 0·12 per cent undissolved. Roll sulphur when treated with bromine dissolves completely. The author examined with a spectroscope the vapour overlying a mixture containing SBr; he found that even at 0° the vapour gave the characteristic spectrum of bromine vapour as mapped by Roscoe and Thorpe. If more sulphur were dissolved, however, the spectrum disappeared. Thus, with a layer of liquid 0·5 metre thick, the absorption spectrum ceased to be visible in a liquid containing S_3Br at +42°, S_5Br_2 at +33°, S_2Br at +25°, S_4Br_3 at +13°, SBr at +3°. The author finds that the liquid in large mass begins to boil at 72°, and rises without any pause, so that no evidence of the existence of a definite compound can be obtained by the boiling-points. On mixing bromine and sulphur in the requisite amount a rise of temperature of 20° was observed; some of this rise the author believes to be due to the change of state of the sulphur, because the amount of heat when plastic sulphur is used is distinctly less, only 12°. The author also estimated the sp. gr. of various compounds or mixtures:—S_3Br, 2·293; S_2Br, 2·625; SBr, 2·628; SBr_2, 2·820; SBr_3, 2·880; SBr_4, 2·905, but without obtaining any evidence of the existence of SBr. An examination of the freezing-points showed that the liquids became oily without solidifying, even at temperatures at which bromine is solid. The estimation of the vapour tension was also without avail. If a small quantity of arsenic be dissolved in the liquid SBr, and the mixture cooled to −18°, beautiful dark red crystals are obtained of the composition AsS_2Br_3, probably $AsSBr,SBr_2$. The author therefore concludes that the action of any quantity of bromine on any quantity of sulphur is an action on the whole mass and not in multiple proportion, but that if at low temperatures the compound SBr_2 meets a body with which it can form a molecular combination it assumes the crystalline form in conjunction with such a body. The action of bromine upon sulphur increases in a regular manner up to SBr_2, totally ignoring SBr; above SBr_2 we may have another curve to SBr_4, and another fainter curve to SBr_8, but we have no evidence of the existence of S_2Br_2.

Mr. MUIR thought that there was some evidence of the existence of SBr. In his experiments there seemed to be a stop in the distillation at 200°; this was confirmed by passing CO_2 through a mixture for some time and examining the residue.

Mr. GROVES observed that the rise of temperature which occurred in mixing the two elements did not give the whole of the heat evolved, as some heat must be absorbed by the sulphur in passing from the solid to the liquid state.

The next paper was "*On the Determination of High Boiling-points*," by T. CARNELLY and W. C. WILLIAMS. The determination of the melting-points of a large number of metallic metals by Carnelly enabled the authors, in cases where only approximate results were required, to ascertain the boiling-point of a substance by observing whether or not certain salts fuse when exposed to the vapour of the substance in question when boiling. The metallic salts are contained in capillary tubes. Thus determined, S boils at 446° to 451° (Regnault gives 447°). Anthracene, 339° to 359°; HgI_2, 339° to 359°; AsI_3, 394° to 414°; $BiCl_3$, 427° to 439°; SbI_3, 414° to 427°; $ZnBr_2$, 695° to 699°; $ZnCl_2$, 708° to 719°; TlCl, 719° to 731°; TlI, 806° to 814°; Cd, 772°.

The last paper was "*On High Melting-points*," Part IV., by T. CARNELLY, D.Sc. (Lond.). The author has carefully investigated and got rid of two sources of error which existed previously in his method (*Chem. Soc. Journ.*, 489, 1876). He now uses a much finer platinum wire to suspend the crucible, and has re-determined the value of his calorimeter with very great care. In the present paper he gives the melting-points of over one hundred substances, and promises in a short time some interesting theoretical results, which he has deduced from the above observations; the most important being, that in simply binary compounds if one of the elements remains the same, then the melting-point is a periodic function of the atomic weight of the other. The author also hopes to be able to indicate a method by which many unknown melting-points may be predicted.

After the thanks of the meeting had been given to the authors for their respective papers the Society adjourned to June 6.

PHYSICAL SOCIETY.

May 11, 1878.

Prof. W. G. ADAMS, President, in the Chair.

THE following candidate was elected a Member of the Society:—Rev. P. Magnus, B.A., B.Sc.

Mr. J. NORMAN LOCKYER, F.R.S., read a paper on "*Some Recent Researches in Solar Chemistry*," a report of which is deferred until next week.

Sir WILLIAM THOMSON, LL.D., F.R.S., described and exhibited the apparatus he has employed in recent researches on the influence of stress on magnetisation, a detailed account of which he has just submitted to the Royal Society; he also, in part, described them at the Royal Institution on the 10th inst., but attention was not then directed to the experimental details now brought before the Society. The rod or wire under examination was surrounded by two coaxial wire helices, the outer of which was connected with the battery, and the inner with a ballistic galvanometer; that is, one that acts with regard to electric impulses just as Robins's ballistic pendulum. It was some years ago discovered by Villari that a longitudinal pull augments the temporary induced magnetism of soft iron bars, or wires, when the magnetising force is less than a certain critical value, and diminishes it when the magnetising force exceeds that value; in either case the residual magnetism is augmented when the force is applied, and diminished when it is removed. Sir W. Thomson has found the critical value for soft iron to be about 24 times the vertical component of the earth's magnetic force, or 10 G.C.S. units. In the case of some bars of nickel and cobalt, specially prepared for him by Mr. Wharton, of Philadelphia, he finds opposite effects, so that beyond the critical value pull *increases* the magnetisation. The next branch of the inquiry had reference to transverse stress, obtained by water pressure within a gun-barrel, and it was ascertained to have an opposite effect to that found by Villari, in the case of longitudinal pull; the critical point in soft iron for transverse pull, is at about 25 C.G.S. units. Sir W. Thomson has been examining the effect of torsion on a wire that is at the same time exposed to longitudinal pull, confining himself in his first set of experiments to magnetisation,

under the sole influence of the vertical component of terrestrial magnetism. His results showed, with every amount of longitudinal pull, a diminution of magnetisation produced by torsion in either direction, thus extending a conclusion arrived at by Matteucci, Wertheim, and Wiedemann, regarding the effect of torsion unaccompanied by longitudinal stress. But it now appears that this effect of torsion is very remarkably diminished by a large pulling force nearly reaching the limits of elasticity. In conclusion, Sir W. Thomson called attention to a very different and extremely interesting effect of torsion, discovered by Wiedemann—the development of longitudinal magnetisation in an iron wire by twisting it while a current of electricity is flowing along it. This effect, he pointed out, is just what would result from the œolotropic susceptibility for magnetisation due to the œolotropic stress produced in the outer portion of the wire by the torsion, supposing the tangential magnetising force to be less than a certain critical value, intermediate between the Villari critical value and the more than twofold greater critical value, which Sir William Thomson has found for transverse magnetising force. But he pointed out that another cause was also positively efficient in contributing to Wiedemann's result. This cause is the difference of electric conductivity in different directions, which may be inferred from Sir W. Thomson's early experiments, and from Mr. Tomlinson's recent confirmations and extensions of the conclusions to which he was led regarding the effect of stress on the electric conductivity of metals. It is much to be desired that Mr. Tomlinson should continue his experiments; but in the meantime it may be regarded as almost certain that the electric conductivity in the outer parts of an iron wire twisted within its limits of torsional elasticity is maximum and minimum in the two spirals at 45° to its length; being minimum in that one of them which is in the same direction as the twist, that is, the one corresponding to the maximum extension of the substance; and the conductivity is a maximum in the other 45° spiral, which is the direction of maximum contraction of the substance. The effect of this œolotropic conductivity, if it exists, must be to cause the electric currents to flow in spirals of opposite spirality to that of the twist, and to produce a corresponding amount of longitudinal magnetisation. The effect of this is to develope, at the end by which the current enters, a true North Pole when the twist is right-handed, and a true South Pole when left-handed, which is Wiedemann's result; but if the tangential magnetising force exceeds the critical value, the effect of the œolotropic magnetic susceptibility is opposite to Wiedemann's result; and if this result is still observed with such strong currents as to produce a magnetising force above the critical value, it must be due to excess of effect in one direction, due to œolotropic conductivity above the effect in the opposite direction, due to œolotropic susceptibility. This is a subject of great interest, and requires further investigation.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 5, 1878.

Dr. R. ANGUS SMITH, F.R.S., &c., Vice-President in the Chair.

"*On the Decomposition of Ultramarine by Carbonic Acid*," by Mr. S. SUGUIRA (Student in the Chemical Laboratory of the Owens College.) Communicated by Professor ROSCOE, F.R.S., &c.

It has been proposed to employ ultramarine for the detection of free hydrochloric acid in presence of carbonic acid, on the ground that it is not acted upon by the latter, while the former easily attacks it.* In making some experiments in connection with this subject, I found, however, that carbonic acid itself decomposes ultramarine, as the following experiments will show.

A glass cylinder about a foot in height and an inch in diameter was filled with distilled water, and carbon dioxide evolved from sulphuric and sodium bicarbonate or hydrochloric acid and calcspar, was allowed to bubble up through the column of the liquid. In order to be perfectly sure of the purity of carbon dioxide gas, it was passed through a series of flasks containing distilled water, and then through a long tube containing solid sodium bicarbonate, to keep back any free acid which might be mechanically carried over.

After passing a steady current of the gas through for 15 minutes, the water in the cylinder was tested for acids other than carbonic. The absence of sulphuretted hydrogen was also proved by exposing a paper moistened with lead acetate solution.

Then about 0·07 grm. of ultramarine infused in 2 c.c. of distilled water were added to the water in the cylinder. Within 5 minutes the paper turned brown, showing the presence of sulphuretted hydrogen, which therefore can only be attributed to the decomposition of ultramarine.

In order, however, to ascertain the presence of any alkaline sulphide existing as such and not as a constituent of ultramarine, a large quantity of the latter was treated with distilled water and quickly filtered. The filtrate contained no sulphide. Hence the evolution of sulphuretted hydrogen was really due to the decomposition of ultramarine by the carbonic acid. The colour of the pigment was dulled, but could not be destroyed completely even when metallic chloride existed in the solution.

Through the kindness of Messrs. Jewsbury and Brown, I got a dozen bottles of aërated water, one half of which were charged with 2 grains of sodium chloride in each. The effects of these waters upon ultramarine were compared together week after week by putting 0·07 grm. of the pigment into the cylinder containing these liquids. In all cases the following effect was observed: the decomposition of ultramarine did not commence at once, but on standing for about an hour the paper moistened with lead acetate solution and placed over the cylinder began to be blackened. A few minutes afterwards the odour of sulphuretted hydrogen was distinctly observed. To prove the absence of sulphuretted hydrogen in laboratory air, a similar paper was placed over a jar containing the infusion of ultramarine in distilled water, which remained unchanged during the experiments.

These experiments, though qualitative, show that carbon dioxide in aqueous solution, viz., carbonic acid, can attack ultramarine, and therefore the latter is not a safe indicator of free hydrochloric acid in presence of carbonic if the former exist in very small quantity.

* H. Müller, *Chem. Soc. Jour.*, N.S., viii., 38.

Ordinary Meeting, April 2, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

"*On Aurin*," by R. S. DALE, B.A., and C. SCHORLEMMER, F.R.S.

In a paper read before this Society, on 31st October, 1871, we gave a short account of this colouring matter, which was discovered by Kolbe and Schmitt in 1861. We showed that the commercial product, which is called aurin or corallin, and is obtained by heating of phenol with sulphuric acid and oxalic acid, is a mixture of different bodies from which we isolated a colouring matter which crystallised exceedingly well and for which we retained the name of Aurin.* The analysis of this body gave numbers agreeing with the formula $C_{20}H_{14}O_3$, from which we concluded that it was produced by the action of nascent carbonic oxide on phenol:

$$3C_6H_6O + 2CO = C_{20}H_{14}O_3 + 2H_2O.$$

* A full account of this investigation is found in *Journ. Chem. Soc.* (2), xi., 434.)

We further showed that aurin, when treated in an alkaline or acid solution with zinc-dust, combines, like most other organic colouring matters, with hydrogen, yielding leucaurin, $C_{20}H_{16}O_3$, which readily crystallises in large colourless prisms, whilst on heating aurin with ammonia under pressure a new red colouring matter is formed, which is called red aurin or peonin.

The further investigation of this body showed that it contained nitrogen, which, on heating with soda-lime, was evolved in some cases completely as ammonia, while in others, where the action of the ammonia went on longer it was given off, at least partly, in the form of aniline. We then found, that on continuing the heating, the red colour of the liquid became paler, and at last a yellowish solution was obtained, from which water precipitated a white crystalline body, possessing all the characteristic properties of rosaniline.* The formation of this compound might be explained by the following equation:

$$C_{20}H_{14}O_3+3NH_3=C_{20}H_{17}N_3+3H_2O.$$

But Hofmann, who has most carefully examined rosaniline as well as a great number of its derivatives, found that the formula of this base is $C_{20}H_{19}O_3$, and this result has been confirmed by Caro and Gräbe,† who showed that rosolic acid, which is obtained from rosaniline by a reaction, which shortly may be stated to be the inverse of that above given, has the composition $C_{20}H_{16}O_3$, while its properties are in almost all respects so similar to aurin, that some chemists, including ourselves, have been inclined to regard them as identical.

In order to clear up these points it was necessary to prepare a considerable quantity of pure aurin. We have already shown in our memoir read before the Chemical Society,‡ that a pure compound is readily obtained by heating pure phenol with oxalic and sulphuric acids for a few days to about 105° C. Although a good product is thus obtained, the yield is but small, while on heating the mixture longer or to a higher temperature by-products are formed. Some chemists have stated that the formation of the latter cannot be avoided, and that it is very difficult to obtain thus a pure aurin. We believe that we are able to explain these different results; the formation of a pure compound depends much on the proportions and the manner in which phenol and the acids are mixed. As however, the preparation of pure aurin by this method is a very tedious process, we endeavoured to obtain it from the commercial product by the method which we have described in our first paper, and purifying it by repeated re-crystallisation from alcohol, the crystals separating out first being used for further purification, because we found that the purer aurin is, the less soluble it becomes, its solubility being increased by the admixtures which are present in the crude product.

Another method for purification which we employed consisted in washing good commercial aurin with cold alcohol until only a comparatively small residue was left, which was then further treated as above stated.

The different crops of crystals were analysed, and the purification continued until the product did not change its composition any more. A great number of analyses were thus required, and we have great pleasure in expressing our best thanks to Mr. L. T. O'Shea, who performed them with great care.

The results did not, however, agree with our former; the product having a constant composition, and crystallising exceedingly well, gave numbers agreeing with the formula $C_{19}H_{14}O_3$. We therefore again prepared aurin from pure phenol, and crystallised it repeatedly from alcohol, until its composition became constant. and found it to have the same formula.

Aurin, therefore, appears to be the lower homologue of rosolic acid; like the latter, it readily forms a tetrabromo-compound, which we obtained pure by the following process. Pure aurin was dissolved in hot glacial acetic acid, and this solution poured into a mixture of an excess of bromine and acetic acid. The liquid remained perfectly clear, but on standing for a few days the tetrabromaurin crystallised out almost completely. It forms small brownish green crystals, with a metallic lustre, which dissolve in alkalies with a purple colour. The determination of the bromine gave numbers agreeing closely with those required for the formula $C_{19}H_{10}Br_4O_3$.

Whilst this investigation was going on a new light was thrown on the subject by the researches of E. and O. Fischer. In order to elucidate the constitution of rosaniline these chemists endeavoured to convert rosaniline into the hydrocarbon from which it is derived. In this they did not succeed, but they were able to transform leucaniline, $C_{20}H_{21}N_3$, which stands to rosaniline in the same relation as leucaurin to aurin, into a hydrocarbon, $C_{20}H_{18}$, which is the mother substance of this base, and from which it follows that the hydrocarbon corresponding to rosaniline has the composition $C_{20}H_{16}$, which also confirms the correctness of Hofmann's formula for rosaniline. The leucaniline, which they employed was obtained from commercial rosaniline; but Rosenstiehl has shown that this body, which is prepared by oxidising a mixture of aniline, solid paratoluidine, and liquid pseudotoluidine, contains several, probably isomeric, bases. E. and O. Fischer therefore, in continuing their research* prepared one of them in the pure state by using a mixture of pure aniline and pure paratoluidine. The product was converted into the leuco-compound, from which, to their surprise, they obtained, not as before, the hydrocarbon $C_{20}H_{18}$, but one having the composition $C_{19}H_{16}$, or the lower homologue of the former. They found the new hydrocarbon to be identical with one already known, which was discovered by Kekulé and Franchimont, and called Triphenyl-methane, $CH(C_6H_5)_3$, as it is a marsh-gas or methane, in which three atoms of hydrogen are replaced by three phenyl-groups. Hemilian, who afterwards obtained the same hydrocarbon by a different method, examined it more fully, and found amongst other results that concentrated nitric acid converts it into the tri-nitro-compound $C_{19}H_{13}(NO_2)_3$; E. and O. Fischer prepared the same body, which, by the action of nascent hydrogen was converted into a base, having all the characteristic properties of leucaniline. This was heated with arsenic acid, in order to abstract hydrogen by oxidation, and the rosaniline which formed the starting point of their last investigation was obtained again.

From these results it follows that commercial rosaniline consists principally of the base $C_{20}H_{19}N_3$, and is probably a derivative of pseudotoluidine, while the rosaniline from paratoluidine, and which has therefore been called para-rosaniline, is its lower hololog ue, having the formula $C_{19}H_{17}N_3$. The rosaniline which we obtained from aurin is undoubtedly identical with the latter,† its formation being readily explained by the following equation:—

$$C_{19}H_{14}O_3+3NH_3=C_{19}H_{17}N_3+3H_2O.$$

The question which now has to be solved is how to explain the formation of aurin; we have already made experiments in this direction and obtained interesting results, which, however, are not yet sufficiently worked out to publish them.

Another question to be elucidated is, what is the chemical constitution of aurin? According to E. and O. Fischer that of pararosaniline is $C_{14}H_{11}(NH_2)$, from which it follows that aurin is $C_{14}H_{11}(OH)_3$. Already, in our first research, we obtained results which seem to confirm this view. On heating aurin with acetyl chloride, we obtained a colourless crystalline compound, which, on analysis, gave results nearly agreeing with the composition of triacetyl aurin, $C_{19}H_{11}(OC_2H_3O)_3$, and on using benzoyl

* *Journ. Chem. Soc.* (2) xi, 434.
† *Liebig's Ann.* clxxix, 148.
‡ *Journ. Chem. Soc.* 1877, ii., 121.

* *Ber. Deutsch. Chem. Ges.*, xi., 195.
† Since this was written, E. and O. Fischer prepared some pure aurin according to our directions, and converted it into a leucorosaniline, from which they also obtained triphenylmethane (*Deutsch. Chem. Ges. Ber.*, xi., 473).

chloride a similar benzol-compound was obtained. The analytical numbers did not, however, sufficiently agree with those required by theory, and therefore we did not publish them; and, as the purification of these compounds was found to be beset with several difficulties, we did not then examine them further, because we believed the study of red aurin would more readily throw light on the subject. We have now prepared them again from pure aurin, and hope to be soon able to settle these points.

"*The Origin of some Ores of Copper.*" Part II. By CHARLES A. BURGHARDT., Ph.D., the Owens College.

Atacamite.—This interesting and beautiful mineral occurs generally in radiating foliated masses, or in bundles of acicular crystals, which are characterised by a fine vertical striation upon their vertical faces. Globular, reniform, and stalactitic atacamite is also known. Thus it is safe to infer that in a great majority of cases the mineral has been formed in some way from a solution of copper salt, and not by ingenious action. It is also a well known fact that atacamite crusts are occasionally found resting upon clefts in the lava of some volcanoes, being formed by the action of hydrochloric acid gas evolved by the volcano upon copper, or a compound of that metal, but these crusts are insignificant in quality, and comparatively scarce. In Chili, Bolivia, and the West Coast of Africa, very large quantities of atacamite are obtained as a commercial product; it therefore becomes interesting to the mineralogist to ascertain under what conditions these formations arose, and in order to do this a thorough chemical examination of the mineral itself is necessary. Atacamite is known to occur in nature in three states of hydration, and as an example of the first I may mention a specimen from Algodon Bay, Bolivia, analysed by Bibra (*Jahresbericht*, 1858, 740), which had the following composition, viz.:—

Cu	59·25 per cent.
Cl	16·11 ,,
O	12·51 ,,
H_2O	12·13 ,,
	100·00

The formula corresponding with the above analysis being $Cu_4O_3Cl_2+3H_2O$. The atacamite of Copiapo, Chili, as analysed by Field (*Journ. Chem Soc.*, (7), 3, 193) has the following composition, viz.:—

Cu	56·38 per cent.
Cl	14·95 ,,
O	10·78 ,,
H_2O	17·89 ,,
	100·00

The formula for this being

$$Cu_8O_6Cl_4+9H_2O, \text{ or } (Cu_4O_3Cl_2)_2+9H_2O.$$

The third state of hydration is represented in the atacamite from Botallack, Cornwall, analysed by Church (*Journ. Chem. Soc.*, (2), 3, 212), and that from Tocopilla, near Cobija, Bolivia, analysed by Berthier (*Ann. des Mines*, (3), 7, 542), the composition being as follows:—

Botallack Atacamite.		Tocopilla Atacamite.	
Cu	52·90	Cu	53·26
Cl	14·76	Cl	14·92
O	10·49	O	9·37
H_2O	22·45	H_2O	22·45
	100·00		100·00

and the formula $Cu_4O_3Cl_2+6H_2O$.

Having given a general idea of the composition of the various atacamites, I will now point out how some of them can be prepared artificially. Field (*Phil. Mag.*, (4), xxiv., 1862, 124) prepared the last-mentioned variety by adding a solution of calcium hypochlorite to an excess of cupric sulphate, and boiling the mixture for some time, when an apple-green precipitate was observed, which proved on analysis to be identical with Berthier's atacamite from Cobija. If the ebullition were not sufficiently kept up, the compound was found to contain only 4 atoms of water. Proust prepared a green compound (which no doubt was atacamite, although its exact composition is not given) by exposing moist cuprous chloride to the air, also by digesting a solution of cupric chloride with cupric oxide. In a former communication to this Society (*Proc. Lit. Phil. Soc.*, xvii., 1877-78, 27—36) I mentioned that on heating some crystals of cuprous chloride in water in a sealed tube at a temperature ranging from 160°—180° C°, that minute green spots of a substance resembling atacamite were observed upon the sides of the tube. Further on, heating cuprous oxide and a strong solution of chloride of sodium together in a sealed tube, at 150°—180° chalcotrichite was formed, and also a green substance resembling atacamite. Wishing to ascertain whether atacamite could be prepared in larger quantity (in accordance with my supposition that all the copper ores are products of the decomposition of cuprous oxide, the latter substance being a secondary product of the oxidation of the metal itself), I made numerous experiments, mostly consisting in the heating of cuprous oxide with sodium chloride solution in sealed tubes, and obtained excellent results, by simply covering a quantity of cuprous oxide with a concentrated solution of sodium chloride, exposing this mixture to the air at the ordinary temperature, and stirring it up occasionally. By proceeding in this way a very concentrated solution of cuprous chloride in sodium chloride can be obtained. After standing a few days this solution begins to decompose, a green insoluble substance separating out continually, which can easily be filtered off from the liquid portion and well washed in cold distilled water, in order to free it from all traces of cuprous chloride and sodium chloride. The substance thus obtained was carefully dried over calcium chloride until its weight was constant, and portions weighed out and analysed quantitatively with the following result, viz:—

Cu	56·25 per cent.
Cl	14·29 ,,
O	10·95 ,,
H_2O	18·51 ,,
	100·00

It will readily be seen that the above analysis agrees very closely with one made by Field already referred to; whence it follows that the substance prepared by myself is identical in composition with the atacamite of Copiapo, Chili. The *rationale* of the formation is briefly this—"The cuprous chloride held in solution by the sodium chloride takes up oxygen from the air very rapidly, giving rise to the formation of cupric oxychloride and cupric chloride (the latter soluble in water), both eventually becoming hydrated." The following equation expresses the first stage of the reaction, viz:—

$$3Cu_2Cl_2+O_3=CuCl_23CuO+2CuCl_2.$$

Nearly all specimens of atacamite are intimately associated with cuprite, so that it appears highly probable that the former mineral has been obtained from the latter in the manner stated, more especially as atacamite is found in veins of other copper ores, associated with quartz, chalcedony, &c., in diorite and syenite. Again, at Sierra do Lembe, near Ambriz, on the West Coast of Africa, there is a large occurrence of atacamite in the malachite deposits, the "gangue mineral" being quartz. Debray (*Zeitsch. f. Chem.*, 1867, 276) prepared crystallised atacamite by heating together basic cupric nitrate and a concentrated sodium chloride solution for several hours at 200° C., also by heating copper ammonium sulphate with a strong sodium chloride solution at 100° C. Up to the present time I have not succeeded in preparing the mineral in a crystalline state. A curious fact I may mention, viz., that natural cupric oxychloride should increase in hydration by three atoms of water.

EDINBURGH UNIVERSITY CHEMICAL SOCIETY.

Ninth Meeting, May 15, 1878.

JOHN GIBSON, Ph.D., F.R.S.E., in the Chair.

A PAPER was read by W. INGLIS CLARK, D.Sc., "*On the Gallate and Tannate of Iron*," in which he reviewed the work of previous experimenters, and then detailed the results which he had himself obtained in a very extensive experimental investigation into the nature and properties of these substances, and the modifications they undergo when exposed to the action of acids, sugar, and other bodies. A series of curves, embodying the results of these experiments, were exhibited, and showed clearly the interesting deductions which the author was able to make from them. It was further shown that by the action of aqueous gallic acid on metallic iron a black compound was obtained, which, when heated to 120° C., gave a percentage of iron corresponding to the formula $FeC_7H_3O_5$, while before heating it corresponded to the salt—

$$FeC_7H_3O_52H_2O.$$

Two combustions, closely agreeing, gave a deficiency of carbon of about 4 per cent; thus opposing the view that the body under question was ferric gallate. The author is further investigating the matter.

DUBLIN UNIVERSITY EXPERIMENTAL SCIENCE ASSOCIATION.

A GENERAL Meeting of the above Association was held in the Museum Buildings (New Square), Trinity College, on Wednesday, May 8th, 1878.

Communications.—G. F. Fitzgerald, F.T.C.D.—On Surface Tension, and its Possible Relation to Muscular Contractions. Professor Reynolds, M.D.—Note on Specimens of "Maltose," or Malt Sugar. Edward G. Hull.—An Algebraic Proof of Wheatstone's Bridge. Denis M'C. Mahony, B.A.—Note on the Dibasicity of Carbonic Acid.

Exhibitions.—Professor Reynolds, M.D.—A Large Specimen of Tetrabromide of Silicon; Large Specimens of Tetrachloride of Silicon. Edward G. Hull.—A Simple Current Reverser.

CORRESPONDENCE.

NITRIC ACID IN THE VITRIOL MANUFACTURE.

To the Editor of the Chemical News.

SIR,—The letter which appeared in your issue of the 10th inst. from Mr. Davis, headed "Nitre Losses in the Vitriol Manufacture," is one which it would be a mistake to allow to pass unnoticed. It is really too much to expect that your readers are to be treated in the manner in which Mr. Davis has done in connection with the subject of the loss of nitre. He makes the most distinct assertion (*vide* CHEMICAL NEWS, vol. xxxvii., p. 117)—which with other of his statements has been copied in the United States and elsewhere—that the loss of nitre is caused by the reaction of the N_2O_3 on the As_2O_3 in the acid run down the absorber; and now it seems as if he imagined that your readers are to rest satisfied with his recent letter and explanation that "I have pointed out that the loss of N_2O_3 is *nearly equal* to the amount which *would* be decomposed by the arsenic run down the absorbing tower —*a strange coincidence*" (the italics are mine). Surely, Sir, we have a right to expect from one who undertakes —with such a preliminary flourish of trumpets—to enlighten us on such a subject more than a mere statement of a strange coincidence. I do not wish it to be inferred that I think Mr. Davis's work altogether to be condemned; far from it. What I object to is his drawing conclusions in such a rash way from what were in themselves no doubt perfectly good experiments in so far as they go.

In his last letter the statement is made that "I consider to have proved that in the vitriol manufacture, working *without towers*, the whole of the nitre can be accounted for as in the instances A, B, C, and D given." I consider that he has done nothing of the kind. Take these cases, and we have, in A, 4 testings = 4 cubic feet taken from 5,491,463 cubic feet passing per week with variations in the tests from 1·8 to 2·6, or say 100 to 144.

Case B.—4 testings = 4 cubic feet taken from 8,567,200 cubic feet passing per week, with variations in the tests from 0·72 to 3·57, or as near as possible 100 to 500.

No attention seems to have been paid to the stock of acid in process, and its variations in percentage of nitrous compounds, a very material element in such a calculation.

Cases C and D having been "only occasionally watched," there being only two tests of each, it would be an utter waste of time to discuss such figures.—I am, &c.,

JAMES MACTEAR.

St. Rollox, Glasgow, May 14, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 15, April 15, 1878.

Action of Oxygen upon Acid Chlorides and Analogous Compounds of Tin, Silicium, and Boron.—M. Berthelot.—From the author's observations it results that the provisions of electro-chemical theory are confirmed on a detailed study of the reciprocal displacements between oxygen, chlorine, bromine, and iodine, both with the metals and non-metals.

New Compound of Palladium.—H. Sainte-Claire Deville and H. Debray.—On heating a solution of palladium chloride, PdCl, with strong nitric acid in presence of sal-ammoniac the palladium is converted into an ammonia-chloride, $PdCl_2+NH_4Cl$, which precipitates in small regular octahedra of a fine red colour, sparingly soluble in water, and like the corresponding compounds of iridium and platinum, almost insoluble in a concentrated solution of sal-ammoniac. The authors thought that on treating with aqua regia certain mother-liquors containing ammoniacal palladium chloride (dipalladamine chloride, $PdCl,2NH_3$) with excess of ammonium chloride the metal would be entirely thrown down as a double chloride—an expectation not fulfilled. Instead of the desired compound they obtained a reddish black substance $Pd_2Cl_3,2NH_3$, the result of the combination of ammonia with a palladium chloride hitherto unknown.

Equivalent of Gallium.—Lecoq de Boisbaudran.—The existence of several chlorides of gallium has prevented the author from determining its equivalent by weighing the chloride or bromide of silver without having previously ascertained the conditions under which these salts are obtained in a state of purity. He has determined the equivalent by the calcination of gallo-ammoniacal alum, and by igniting the gallium nitrate produced from a known weight of the metal. The slight losses sustained in these two operations affect the value of the equivalent in an opposite manner. The former process gave as the result 70·032 (H=1), and the latter 69·698. The mean value, 69·865, may be taken as the first approximation. Considerations founded upon a classification of the ele-

ments in accordance with their properties and the value of their atomic weights point to a maximum number, 69·97, and a minimum, 69·66 (mean 69·82). The author enters into some details on the comparison of the spectra of the metals Al, Ga, In, on the one hand, and K, Rb, Cs, on the other, and deduces, hence, for the equivalent of gallium the value 69·86.

Theory of the Propagation of Electricity in Conductors.—M. Mascart.—A mathematical paper not adapted for abstraction.

Heat of Formation of Metallic Chlorides United with Ammonia.—M. Isambert.—Zinc chloride at a moderate temperature is capable of partially decomposing ammonium hydrochlorate and expelling the hydrochloric acid. At first sight this effect might be assimilated to the reaction of a fixed acid which liberates one more volatile; but the phenomena of equilibrium which preside at this deplacement show a connection at once with the principle of a thermic maximum and with dissociation.

Dissociation of Chloral Hydrate.—MM. Moitessier and R. Engel.—The authors contend that the vapour of boiling chloral hydrate is dissociated.

Isomerism of the Amylens.—A. Wischnegradsky.—The author considers that M. Etard's amylen is not isopropylethylen, but trimethylethylen.

Revue Universelle des Mines, de la Metallurgie, &c., Tome 3, No. 1, Jan. and Feb., 1878.

This issue contains no original chemical matter.

Les Mondes, Revue Hebdomadaire des Sciences, No. 15, 1878.

This issue contains nothing of general interest.

NOTES AND QUERIES.

Chloride of Zinc.—Can anyone kindly state if chloride of zinc is a refuse product in any manufacture, and if it can be had cheap? also the nature and composition of Peacock's composition for painting ships' bottoms, and if patented?—C. H. A.

MEETINGS FOR THE WEEK.

SATURDAY, 25th.—Physical, 3. "On Brass Wind Instruments as Resonators," Mr. J. N. Blackley.
MONDAY, 27th.—Royal Geographical, 1 (Anniversary).
TUESDAY, 28th.—Civil Engineers, 8.
— Royal Institution, 3. "On Some Points in Vegetable Morphology," W. T. Thiselton Dyer, M.A.
— Anthropological Institute, 8.
WEDNESDAY, 29th.—Society of Arts, 8.
THURSDAY, 30th.—Royal Institution, 3. "On Molecular Physics: Gases," Prof. Guthrie.
FRIDAY, 31st.—Royal Institution, 8, Weekly Meeting. "The Native Races of the Pacific Ocean," Prof. Flower, 9.
SATURDAY, June 1st.—Royal Institution, 3. "On Richard Steele," (Additional Lecture), Prof. Henry Morley.

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NOTICE IS HEREBY GIVEN, That the next Half-yearly Examination for MATRICULATION in this University will commence on MONDAY, the 24th of June, 1878. In addition to the Metropolitan Examination, Provincial Examinations will be held at Owens College, Manchester; Queen's College, Liverpool; Queen's College, Birmingham; St. Cuthbert's College, Ushaw; Stonyhurst College; St. Patrick's College, Carlow; St. Stanislaus College, Tullamore; and University College, Bristol.

Every Candidate is required to transmit his Certificate of Age to the Registrar (University of London, Burlington Gardens, London, W.) at least Fourteen Days before the commencement of the Examination.

WILLIAM B. CARPENTER, M.D., Registrar.

May 21st, 1878.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 22, Albemarle Street, W.—The NEXT ANNUAL GENERAL MEETING will be held at DUBLIN, commencing on WEDNESDAY, August 14.

President-Elect.

W. SPOTTISWOODE, Esq., LL.D., F.R.S., F.R.A.S., F.R.G.S.

NOTICE to CONTRIBUTORS of MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committee of doing justice to the several Communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section ....." If it should be inconvenient to the Author that his Paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M.A.,
Assistant-General Secretary, Harrow.

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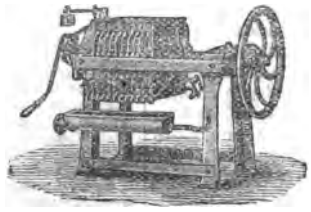

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THE CHEMICAL NEWS.

Vol. XXXVII. No. 966.

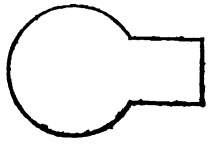
HOFMANN'S METHOD FOR THE DETERMINATION OF VAPOUR DENSITIES.

By WILLIAM A. TILDEN.

The great advantages of this method have led to its very general adoption by chemists, not on the score of special accuracy, which it does not possess, but because it affords a rapid process whereby approximate results are easily obtained applicable to the determination of molecular weights. The original process has been slightly modified in detail and simplified by Hofmann himself (*Deut. Chem. Ges. Ber.*, ix., 1304), by Wichelhaus (*Ber.*, iii., 166), by Brühl (*Ber.*, ix., 1368), and by Muir (*Journ. Chem. Soc.*, 1877, ii., 140).

The following is a description of the apparatus and process I have been using for some time. It costs little and is very easily managed, and gives good results. Its principal features are these:—The trough is of wood, the plate upon which the tubes rest is fixed, no special condenser for recovering the vapour of the aniline is necessary, and the volume occupied by the vapour of the substance is determined, not by weighing mercury, but by the far easier, and for this purpose equally accurate, plan of measuring an equal bulk of water.

The trough is cut out of a solid block of sycamore wood, 200 m.m. long, 120 m.m. wide, and 85 m.m. deep. It is excavated into a circular well, about 80 m.m. in diameter, and 56 m.m. deep, with a trough of the same depth extending from it 50 m.m. towards one end of the block. The cavity, when seen from above, has this shape—



A groove is cut longitudinally at the bottom sufficiently deep to allow a piece of glass tubing, about 6 m.m. in diameter, to lie in it. One end of the groove is continued into a cylindrical hole, which passes quite through the side of the well.

In this groove are placed two short pieces of glass tubing—each bent in the middle to a right angle, and so disposed that one end of each stands up vertically near the middle of the well. One of these is attached below to a piece of stout india-rubber pipe, which passes through the hole in the side and fits tightly into it. A thick and firm sheet of india-rubber is cut to the same size as the well, and has two holes bored in it, through which the upright portions of the glass tubes project. This sheet of india-rubber is glued to the bottom of the well. It is not absolutely necessary, but it affords a bed upon which the barometer and jacket may safely stand, and it also serves to protect the tubes below from injury.

The use of the two tubes is obvious. The one which opens into the groove below is cut off just above the surface of the caoutchouc plate. Over the open end of this the barometer is inverted, the tube serving to keep up free communication with the mercury outside. The office of the other tube is to convey away the steam or vapour of aniline employed as the source of heat. This tube stands up 35 m.m. above the surface of the caoutchouc plate. When the trough is to be used mercury is poured into it till the end of the short tube is submerged, whilst the mouth of the tube, which is to convey away the excess of vapour and condensed liquid, must of course remain uncovered.

The barometer tube is not graduated, neither is it necessary that it should be of perfectly uniform bore. To keep it upright a flat piece of cork is fastened at right angles to the upper part of the tube, and of such size as very readily to slide in and out of the external wider tube or jacket.

The mantle or jacket is a wide glass tube, ground flat at each end. It is a metre long, 50 m.m. in external diameter, and somewhat less than 2 m.m. thick. The upper end is fitted with a good cork (india-rubber stoppers cannot be used), through which passes the tube which conveys the steam or other vapour from the boiler. A thermometer also passes through this cork, and a short piece of glass tube having a stopcock, or closed by a piece of india-rubber tube with a clip. This stopcock enables the operator to regulate the pressure inside the jacket, when from irregular ebullition or condensation of the vapour there might be a risk of the mercury inside being drawn up to the mouth of the exit tube. By allowing the lower end of the jacket to stand in the mercurial trough the whole of the barometer is surrounded by vapour, and it is heated throughout to practically the same temperature. The upper part of the jacket should be enveloped in flannel.

For a condenser a straight piece of glass tube is attached to the india-rubber tube projecting from the side of the trough, which is placed at the edge of the table. The condensed liquid, and ultimately the vapour, is thus conveyed into a Winchester quart bottle containing a little water and standing upon the ground. When aniline is used condensation and recovery of the whole of the vapourised liquid is ensured in this way, and the water can afterwards be drawn off by means of a syphon. The presence of a little water in the aniline is no disadvantage, but is, on the contrary, of use, inasmuch as it effects the heating of the jacket and barometer more gradually than when dry aniline is employed.

After the introduction of the substance and its conversion into vapour, when the mercury in the tube has become stationary, the level of the upper surface of the meniscus is read off by the pendulum cathetometer, which must not afterwards be disturbed. The tubes are allowed to cool, the mantle carefully removed, and the barometer fixed upright by a clamp. A strip of gummed paper is then, as recommended by Hofmann, attached to the tube so that its edge is exactly on a level with the wires of the cathetometer. The barometer tube is then emptied, and to ascertain the volume the vapour had occupied it is only necessary to allow water to flow into it with all the usual precaution, from a burette till the lower surface of the curve corresponds with the edge of the paper. In this measurement the alteration in the capacity of the tube by reason of difference of temperature is left out of account. But this is compensated closely enough by the presence of the little bottle and its stopper, both of which occupy space that is reckoned as vapour. These corrections, therefore, cancel each other and may be disregarded. At the temperature of boiling-water the tension of mercury vapour is insignificant. But when aniline vapour is used it must not be neglected. Regnault's table gives the tension for intervals of 20°. The following are the values for every 5° between 180° and 200° obtained by interpolation from his numbers:—

185°	13·0 m.m.
190°	15·0 m.m.
195°	17·5 m.m.

It only remains to be added that the apparatus is very suitable for lecture demonstration. I have on several occasions exhibited the process to my classes. Having weighed the substance before the lecture, the whole operation of determining the vapour density of chloroform in steam occupied less than one hour; and this included the working out of the calculations on the black-board.

A PROCESS FOR COATING IRON WITH MAGNETIC OXIDE BY THE ACTION OF HEATED AIR.

By GEORGE R. TWEEDIE.

THIS process (invented by Mr. G. Bower, of St. Neots) is of a peculiarly interesting character, and a few words concerning it will not be out of place in this journal.

The idea of the process is, of course, to coat the iron with a film of magnetic or ferroso-ferric oxide (Fe_3O_4), and in this way protect it from ordinary oxidising influences. The details of the process are of the simplest possible character. The articles to be treated are placed in a chamber of fire-clay or iron capable of being raised to a red heat. This chamber is fitted with two pipes closed by cocks, one of which is to serve as an inlet and the other as an outlet for the air. The articles in the chamber having been raised to a sufficiently high temperature (ranging between 1600° and 1900° F.), air is passed in, and the inlet and outlet pipes closed for one hour, when they are again opened, and sufficient air sent in to drive out the whole of that deoxidised, the chamber being again closed. This renewing of the air is carried on until a sufficient thickness of the magnetic oxide is formed.

The magnetic oxide produced in this way has a beautiful light grey or neutral tint of a most delicate appearance, which most perfectly protects the iron from rusting under any ordinary conditions.

One experiment that was tried in the course of the investigation merits some attention. A square cast-iron bar was placed in the main duct of the hot-blast supplying the furnaces of Messrs. Cochrane, of Dudley. After six hours it was withdrawn, and found to be perfectly coated with the magnetic oxide; and the coating, although subjected to the severest possible tests for the past nine months, has completely protected the iron from rust.

An extended and laborious series of experiments has been carried out in connection with the process, and in many cases results have been obtained which possess features of peculiar interest to chemists, and I hope shortly to be able to publish in this paper some of the more important of them.

SOME REMARKS ON THE PREPARATION OF STEEL PLATES FROM BESSEMER INGOTS.

By SERGIUS KERN, M.E., St. Petersburg.

THE author must premise that much in this article may not be new for managers of steel works, but certain remarks on steel plate rolling may be of use to persons who have had only a small practice regarding the manufacture of plates from Bessemer steel.

At present, steel plates are used in enormous quantities, and certainly for most purposes iron will be replaced by the cheap steels, viz., Bessemer and Siemens-Martin metals. Steel plates for shipbuilding, boilers, &c., are constantly prepared by steel works, and a special report on steel for shipbuilding, issued by the inspectors of Lloyd's, clearly shows that certain English works yield steel plates of a superior quality, which may be stated to be the best in the trade. The Bolton Steel Works for instance, in preparing plates, use superior raw materials, as may be seen by considering the following analyses of thin plates of their manufacture:—

	per cent. I.	II.
Combined carbon	0·07	0·08
Silicon	traces	traces
Phosphorus	0·05	0·04
Manganese	0·19	0·16

In preparing steel plates, good and clean raw materials are especially wanted. But even having steel of good quality, as to its chemical composition, the influence of certain surface defects of the ingots, and the mode of working the steel, have such a great influence on the steel rolling, that often good steel gives smooth plates, the surface of which are full of small excavations and flaws.

Most of the ingots from Bessemer steel are full of blow-holes in the interior, and several of the ingots have surface blow-holes, which always have a connection with the interior blow-holes. The air and the moisture enter, by means of these holes, into the ingot, and oxidise the surface of the blow-holes in a few days. This may be easily seen by breaking such an ingot under a steam-hammer. Certainly such ingots when rolled will give plates with interior flaws, arising from the contraction of the blow-holes. The surface blow-holes produce a very strange phenomenon:—A plate in hot state nearly always looks satisfactory, but just as it is cooled and slightly touched by a hand-hammer, in different places from its surface jump out small round pieces of the metal, which give rise to excavations. This defect may only arise from the presence of surface blow-holes in the ingots. These blow-holes, by rolling, are only squeezed together as the thin layer of the oxide coating in the holes prevents them welding firmly together.

That these roundish pieces are not composed of slag is seen by their aspect and the following analyses:—

Per cent of carbon. Ingots.	Roundish pieces.
0·23	0·22
0·24	0·24
0·23	0·23
0·25	0·24
0·23	0·22
0·08	0·07

A loss of 0·01 to 0·04 per cent of carbon may happen, as the ingots before rolling are heated in furnaces for 1 to 1½ hours. The ingots are protected from oxidation by covering them by charcoal, and by introducing with the coal pieces of wood dipped into tar in order to obtain a reducing and carbonaceous flame.

The forging of the ingots, after casting, just before rolling them into plates, is not a new idea, but being a rather expensive one is at present nearly abandoned, but altogether the author's opinion is that the only method which gives clean plates is the forging of the ingots *immediately* after casting them. The surfaces of the blow-holes are then clean and easily weld together. Certainly, if blow-holes could be avoided, the manufacture of the plates would be cheaper, but this is still the *bête noire* of metallurgists. M. Gautier tells us that silicon stops the formation of blow-holes, but for steel plates a metal containing much silicon is useless.

Obouchoff Steel Works.

SYNTHESIS OF PHTHALIC ACID.

By M. A. GUYARD.

THE phthalic acid here treated of is that derived from naphthalin, and which on fusion with resorcin yields fluorescein, and ultimately eosin.

Synthesis of Phthalic Acid from Salicylic Acid and Carbonic Oxide.—Oxygen, as is well known, is easily fixed upon benzol, so as to yield phenol. Phenol readily absorbs carbonic acid, yielding salicylic acid, and the author has found that the latter, in turn, takes up carbonic oxide with not less avidity, so as to form phthalic acid;—

$$C_6H_6+O=C_6H_6O.$$
$$C_6H_6O+CO_2=C_7H_6O_3.$$
$$C_7H_6O_3+CO=C_8H_6O_4.$$

To effect this synthesis two methods are available:—The one, somewhat rude, consists in heating a mixture of sulphuric acid and potassium ferrocyanide with salicylic acid. When the reaction is over, the phthalic acid is extracted from the mass by treatment with ether. The second method, which is more elegant, consists in heating, as long as gas is evolved, a mixture of sulphuric and formic acids along with salicylic acid. The residual mass is exhausted with the ether, and the extract on evaporation leaves perfectly pure phthalic acid, identical with that obtained from naphthalin. No other product seems to be formed in the reaction.

Synthesis of Phthalic Acid from Resorcin and Carbonic Oxide.—Benzol combines with two atoms of oxygen to form resorcin, and the latter combines with carbonic oxide, yielding phthalic acid. But as this acid is always produced in presence of an excess of resorcin, combination takes place, and fluorescein is at once produced. The synthesis of phthalic acid and that of fluorescein are thus effected at once. For this purpose it is sufficient to heat a mixture of resorcin, and of sulphuric and formic acids. The result, when neutralised with an alkali, shows the beautiful yellow-green fluorescence characteristic of fluorescein. This reaction is exceedingly elegant, no other product being formed.

Synthesis of Phthalic Acid and Fluorescein from Salicylic Acid, Resorcin, and Oxalic Acid.—If salicylic acid is heated with sulphuric and oxalic acids, or if resorcin is heated with the same two acids,—that is to say, with a mixture evolving at once carbonic acid and carbonic oxide,—neither phthalic acid nor fluorescein is obtained. There are formed in this case substances resulting from the combination of salicylic acid, or of resorcin, with carbonic oxide and carbonic acid, but no phthalic derivatives. If, on the contrary, salicylic acid or resorcin is heated with a mixture of oxalic acid and glycerin,—that is, a mixture capable of yielding carbonic acid in the first stage of the operation and carbonic oxide in the second,—phthalic acid or fluorescein appears as soon as carbonic oxide is evolved. These syntheses prove that phthalic acid is the converging point of the two series, benzol and naphthalin. It is derived from the one by construction, and from the other by destruction.

Synthesis of Phthalic Acid from Benzoic Acid.—It is known that phthalic acid is readily transformed into benzoic acid, but the inverse reaction is not easy to effect. But if benzoic acid is carefully heated with bicarbonate of soda and resorcin, and the mass treated with water, a solution is obtained having all the characters of fluorescein.

Synthesis of Phthalic Acid by Juxtaposition and Destruction.—It is highly probable that every mixture which is not physically separated with too great ease, and which contains C_9H_7 to $C_{10}H_8$, will yield, on chemical destruction and decomposition, a little phthalic acid. The author has succeeded in obtaining small quantities of phthalic acid by boiling a mixture of benzyl chloride, C_7H_7Cl, carbon chloride, C_2Cl_6, and nitric acid. The chlorides of benzyl and of carbon do not combine, but they remain for a long time in juxtaposition, and a point arrives when phthalic acid is formed.—*Bull. de la Soc. Chimique de Paris.*

Solids in Milk.—According to the *Chemiker-Zeitung* (No. 17, April 26, 1878), a certain Theodor Kyll, of Cologne, vouches for the excellence of the milk, sold in G. Palant's Milk-Cure Establishment, in that city, on the mere ground that it contains 12·70 per cent of total solids. Dr. H. Vohl points out the utter insufficiency of a determination of total solids, and shows that the quantity given by Kyll is decidedly below the average, which is, according to Liebig, 14, and according to Reichardt, 13·725 per cent.

IMPROVEMENTS IN THE METHOD OF PRESERVING ANIMAL AND VEGETABLE FOOD.

We have received a number of biscuits and other preparations containing preserved solid and liquid food, both animal and vegetable, which are the practical results of a new process lately patented by Dr. Campbell Morfit. They include substances of the most diverse nature, such as milk, cream, cheese, beef, garden rhubarb, cabbage, tomato, pork sausage, and a variety of other alimentary products, all of which are perfectly savoury and toothsome, in spite of their being more than a year old. It is, however, more with Dr. Morfit's process than with its present results that we have now to deal, for we must look upon his discovery as being as yet in its infancy.

Dr. Morfit's experiments, which he has prosecuted uninterruptedly for the last two years, seem to prove that ordinary gelatin, when it is once thoroughly diffused through a vegetable or animal substance, and dried in and with it, will protect it from decomposition or other alteration for a prolonged period, in spite of atmospheric or climatic changes. This is clearly proved by the samples submitted to us, which—although they have been exposed to the constant changes of temperature and moisture consequent on their having been kept for more than a year in the store-room of an ordinary dwelling-house—are still perfectly good and sweet, their natural characteristic flavours being well preserved. Some lime-fruit juice biscuits, for instance, which are more than a year old, have preserved, in a very perfect manner, the peculiar flavour by which the juice of the lime can always be distinguished from that of the lemon.

The primary principle of Dr. Morfit's process is the getting rid of nearly the whole of the natural water contained in the substance to be preserved, by submitting it to a certain degree of heat, the place of the water being supplied by gelatin. The compound is then dried, and in this state may be kept for any length of time, or else it may be made up into biscuits by incorporating it with biscuit-powder.

Let us take Dr. Morfit's method of preserving beef as an example. The beef must be as free from fat and bone as possible, and should be first stewed in its own liquor, or with the least possible quantity of water, and seasoned or not according to taste. The whole is then reduced, by any available mechanical means, to a state of smooth and fine pulp, and triturated with a solution of gelatin in water. One pound of gelatin is enough for 15 lbs. of meat, fowl, or fish, the gelatin being dissolved either in a sufficiency of water or in the natural juice of the substance itself. In the case of fruit—such as gooseberries, currants, or plums—they are stoned or skinned when necessary, and cooked or not, as the case may be. They are then made into a pulp and mixed with gelatin dissolved in water or their own juice, heated so as to insure a thorough mixture of the ingredients, and then poured into coolers. In certain cases the gelatin may be replaced by mucilage of Irish moss, but the result, although cheaper, is not so good.

Dr. Morfit's method of condensing milk without the use of sugar is of great interest, seeing that the Swiss and other descriptions of condensed milk, which are now so largely sold, cannot be taken by delicate infants or by persons of weak digestion, owing to the large amount of sugar contained in them. One pound of gelatin is dissolved in 1 gallon of fresh milk at a temperature of from 130° to 140° F., the whole being allowed to set into a jelly, which is dried. The dried jelly is then dissolved in another gallon of fresh milk, and allowed to set and dry as before, the operation being repeated with fresh milk until the original pound of gelatin has taken up eight gallons of milk or more. Consommé of meat may in like manner be condensed until one pound solid shall represent thirty times its weight of fresh beef. As may be readily guessed, the process may be carried on without any of the

expensive plant and troublesome manipulation involved in the usual modes of condensing milk and making Liebig's extract, besides which, in the latter case, the whole of the nitrogenous parts of the meat are preserved intact.

From a hygienic point of view, the lime-fruit juice biscuits ought to be admirably suited for use in the Navy. Without entering into the question as to whether it is the citric acid, or the phosphatic salts, or the potash, contained in the lime-juice that is the real anti-scorbutic agent, it is sufficient to say that the 40 per cent of Montserrat lime-fruit juice preserved by Dr. Morfit's process, and incorporated with the biscuits, has preserved all its properties without any change for more than a year, and, *à priori*, there is no reason to suppose that it would not keep good for ten or twenty times that period. It may be mentioned, in conclusion, that the different jellies may be dried into hard tablets or flakes at a uniform temperature of from 38° to 40° C., and sent into the market in this convenient form, as well as under the more bulky guise of biscuits. A few cases of lime-fruit juice tablets, prepared according to Dr. Morfit's method, would probably have saved the lives of several brave men during the late expedition to the Polar regions.

Speaking from a purely scientific point of view, and judging by the results we have already described, the principle of Dr. Morfit's invention seems to be theoretically a sound one. These results we must regard at present as tentative, and it only remains to the inventor of the process to confer a large benefit on the community by extending its application, thereby notably increasing our not too abundant stock of hygienic and alimentary products.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

May 25, 1878.

Prof. W. G. ADAMS, President, in the Chair.

THE following candidates were elected members of the Society:—W. Kieser, T. McEniry, W. R. Philips, G. M. Whipple.

Mr. D. J. BLAIKLEY read a paper on "*Brass Wind Instruments as Resonators*," describing an attempt he has made to carry into some detail certain acoustical investigations of the late Sir C. Wheatstone, who proved experimentally that a complete cone gave resonance to the same notes as an open cylindrical tube of equal length. A method by which the positions of the nodal points in a cone and in a bugle had been fixed was shown, and attention was drawn to the fact that the position of the centre of magnitude of any closed conical tube was at the same distance from the open end as the centre of magnitude of a closed cylindrical tube of the same pitch. It was then shown that a complete cone cannot be used by the lips as a wind instrument, that conic frustra cannot give resonance to the same series of notes as complete cones, and that, therefore, the conical form must be modified; and, as this modification of form makes the position of a node for every note required more or less coincide with that of the lips, so will the instrument be more or less perfectly in tune. As the number of quarter wave-lengths in a cone or wind instrument is not directly proportional to the vibrational number of the note, as it is in free space or in an open tube, so the velocity of the wave of a given note is not exactly the same as that of another note of different pitch. Experiments were shown to illustrate the effect of varieties of form in producing different qualities of tone, and evidence was given of the existence of very high harmonic or partial tones in the low notes of wind instruments. In the trombone the ninth partial tone (three octaves and a tone above its prime) was thus proved to be sounding, and partial tones up to the sixteenth have been heard. In conclusion a summary was given of the partial tones sounding in the tones of different instruments, and attention was drawn to the chief differences in form which influence quality of tone.

Sir W. THOMSON pointed out the connection between the range of a musical instrument and the phenomena observed in a trumpet-shaped bay between high and low water; and he considered that an investigation of the overtones due to the cavity of the mouth would well repay research in explaining the influence its shape has on the vowel sounds.

Lord RAYLEIGH observed that in a conical musical instrument the correction to be made on account of the cone not being perfect to the apex is equal to six-tenths of the radius of the open end, and he pointed out that with a bell-mouthed instrument much of the sound is diffused as spherical waves.

Dr. GUTHRIE placed on the table a communication on salt solutions and attached water, and on the separation of water from crystalline solids in currents of dry air, in continuation of his researches, which have already been published. The results could not be usefully abstracted, but as an instance of the important results obtained it may be mentioned that Dr. Guthrie finds that when dry air is passed over chloride of barium at a temperature just above 25° C. the β-molecule of water is given off, and that the α-molecule of water is only separated at a temperature just above 60° C. In studying the effect of media other than water in the solution of salts, he finds, for instance, that two solutions of cobalt of equal strength differ greatly as to colour if they are formed with water and glycerin. He has also traced the influence of a colloid in modifying the crystalline form of salts; for instance, sulphate of copper crystallises from gelatin in the globular form, retaining only 3½ molecules of water. He also showed the effect of a steam jet in boring through a block of ice, mainly with a view of obtaining suggestions as to the use of such a method in the commercial preparation of ice.

Mr. RUTHERFORD then showed a photograph of the solar spectrum from the line E to H, taken by means of a grating. By means of a heliostat he concentrated the rays on a lens within a collimator, which, in relation to the observing telescope, was of considerable length in order to admit as much light as possible, and the grating was movable. The enlargement was effected by inserting a lens near the focal point of the observing telescope, and he used a sensitive collodion which gave the greatest sharpness of definition about the line G.

Sir W. THOMSON hoped that Mr. Rutherford would measure the wave-lengths of dull radiant heat, as such rays are not absorbed by speculum metal, and we have as yet no idea of the lower limit of the waves of heat.

Sir W. THOMSON, in continuation of the communication made to the Society at its last meeting, described the effect of torsion on the electric conductivity of a tube of brass. He showed that the effects of pull and thrust were different, and in the case of a tube, as in the case of a plate, there is a diminution in conductivity in the direction of pull; in the case of the tube, however, the components of the forces result in a sort of eschelon arrangement as regards conductivity. The experimental part of the work was conducted by fixing the tube to a collar of brass which was attached to a stand, the tube being arranged in a horizontal position. A magnetometer bearing a mirror could be placed inside the tube, and the changes in its conductivity produced by torsion were rendered evident by a reflected beam of light. The effects were also investigated by placing a core of soft iron in the tube, a balanced magnetometer being arranged outside the tube, near one end of the soft iron. Any changes in the conductivity of the tube induced by torsion were rendered

evident by the changes in the amount of magnetism induced in the soft iron as indicated by the magnetometer.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 16, 1878.

E. W. Binney, F.R.S., F.G.S., President, in the Chair.

"*Note on the Occurrence of Dioptase on Chrysocolla from Peru*," by Charles A. Burghardt, Ph.D., the Owens College.

A short time ago, Mr. W. M. Hutchings, F.C.S., of Birkenhead, sent me some specimens of chrysocolla ($CuSiO_2+2H_2O$), from Peru, accompanied with a statement that there were some minute crystals in a cavity in one or two of the specimens which might possibly prove to be the rare mineral dioptase ($CuSiO_2+H_2O$). I proceeded to make a crystallographical and chemical examination of the crystals, and found that although extremely small, the forms could be recognised under the microscope. The chrysocolla mass is eaten into in one or two spots, cavities being produced, which are divided into numerous cells by the intersection of thin partitions of chrysocolla substance. The dioptase crystals occur particularly fine in small green tufts and sheaves attached to the partition-walls of the cells, whilst those crystals clothing the interior of the cells are not so well developed as the others. The measurements so far obtained have not been satisfactory, owing to the extreme smallness of the crystals, but the forms observed are those peculiarly characteristic of dioptase, viz., $\infty P2$—$2R$; the rhombohedron being extremely well defined. No other forms were observed, but a great many fine acicular sub-individuals growing parallel with each other build up a large individual. Some of the crystals I carefully picked out and examined chemically with the following results, viz.:—Heated before the blowpipe they were infusible and turned brown, *not black*, probably owing to one of two causes, either (1) the flame was not a pure oxidising flame, and a little of the cupric oxide was reduced to cuprous oxide; or (2) there was a slight admixture of quartz with the dioptase crystals. The presence of copper was proved by dissolving a crystal in a drop of hydrochloric acid, evaporating off the latter, re-dissolving the residue in a drop of acetic acid and adding potassium ferrocyanide, when the characteristic copper reaction was very marked. There was not the slightest effervescence on dissolving the mineral in hydrochloric acid, but flocculent particles of silica separated out. Mr. Hutchings obtained identical results in a chemical examination of the crystals. From the above tests, the crystallographical examination, and the fine emerald-green colour of the crystals, there can scarcely be a doubt that they are really those of dioptase. Colourless quartz crystals were also observed associated here and there with the dioptase, but $+R$ and $-R$ were both present, generally nearly in equilibrium, and the prism faces exhibited strongly the characteristic horizontal striation; therefore, coupling the marked differences in colour and crystal-form, a confusion of the two minerals could scarcely be possible.

I believe this is the first instance observed of dioptase occurring simultaneously with chrysocolla, and according to my knowledge the first time it has been found in Peru—in fact, out of Russia. The exact locality of the mine cannot unfortunately be ascertained. I am of opinion that the dioptase has been formed by the action of water upon the chrysocolla, the latter being a product of the decomposition of cuprite (which is always intimately associated with it) by a solution of silicic acid in water. Very fine botryoidal malachite sometimes occurs associated with chrysocolla and cuprite in the same locality in Peru. I hope shortly to obtain accurate measurements of the dioptase crystals.

"*On Indigo-blue from* Polygonum tinctorium *and other Plants*," by Edward Schunck, Ph.D., F.R.S.

The author, after referring to his investigation of *Isatis tinctoria*, the common woad plant, the results of which were communicated to the Society many years ago (*Memoirs*, 2nd series, xii., p. 177, and xiv., p. 181), proceeded to give an account of some experiments he had recently made with *Polygonum tinctorium*, a plant employed by the Chinese for the manufacture of indigo, his object being to ascertain whether the colouring matter is contained in this plant in the same form as in the *Isatis*, viz., as a glucoside. His experiments led to the conclusion that the leaves of *P. tinctorium* contain a substance which cannot be distinguished from the indican of the woad plant. It is amorphous, soluble in water, alcohol, and ether, and by the action of acids is decomposed into indigo-blue and a substance giving the reaction of glucose, probably indigucine. When its watery solution is boiled or left to stand for some time, it undergoes a complete change, and then no longer yields indigo-blue by decomposition with acids, but indigo-red and other products, indican, as formerly shown, undergoing a similar metamorphosis under the same circumstances.

The author recommends for the preparation of this substance the following process:—The leaves of the plant having been carefully dried, are ground to powder, and extracted with spirits of wine. The green alcoholic extract is evaporated at the ordinary temperature, a current of air being employed to assist evaporation. After evaporation of the alcohol there is left a brown watery liquid, which is filtered from the deposited chlorophyll and fatty matters, and mixed with acetate of lead solution. This gives a copious dirty yellow precipitate, which is filtered off. Basic lead acetate added to the filtrate produces a primrose-yellow precipitate, which is filtered off, washed with water, then with alcohol, and then suspended in absolute alcohol. On passing a current of carbonic acid gas through the liquid the precipitate is decomposed, yielding lead carbonate, while the liquid acquires a yellow colour. The filtrate is evaporated in a current of air, and water is added to the residue, which it dissolves for the most part. Sulphuretted hydrogen is passed through the filtrate to precipitate the lead in solution, and the liquid after filtration is again evaporated. The residue is treated with ether, which leaves a portion undissolved. The ethereal solution leaves on evaporation a yellow amorphous residue, having all the properties of indican.

The author made some experiments with the fresh leaves of the plant, from which he concludes that the leaf-cells contain no ready-formed colouring matter with the exception of chlorophyll, and that the indigo-blue which is formed when the vitality of the cells is destroyed by extreme cold, organic lesion, or chemical reagents is produced by the decomposition of indican, which commences as soon as the protecting influence of the living cell is removed.

It has long been known that some orchidaceous plants, such as *Bletia Tankervilliæ* and *Callanthe veratrifolia*, yield indigo-blue. The author examined the leaves of the former plant, and obtained a solution giving the reactions of indican, and he is consequently inclined to suppose that the latter will be found in all cases to be the source from which indigo-blue is derived.

The author mentions a fact which he thinks may be of interest not only to the chemist, but also to the physiologist. On one occasion an alcoholic extract of dried woad leaves, in which the indican had undergone partial decomposition by long standing, yielded on evaporation a quantity of a substance which, when purified, was found to have all the properties of tyrosine. Though it is possible that the tyrosine may have pre-existed in the plant, the author is inclined to think that, like the leucine previously discovered by him, it was a product of decomposition of indican under conditions of which he is at present ignorant, especially as some connection is supposed by chemists to exist between tyrosine and indigo-

blue; and on the other hand, tyrosine and leucine so frequently occur together as products of decomposition of protein compounds.

"*On the Estimation of Hyposulphites and Sulphites*," by J. GROSSMAN, Ph.D. Communicated by Prof. ROSCOE, F.R.S.

Bunsen, in his treatise "On a Volumetric Method of Very General Applicability" (*Ann. Chem. Pharm.*), has shown what degree of exactness may under certain circumstances be attained by indirect analysis. Upon the latter I have founded a very simple method for the estimation of hyposulphites and sulphites, which yields exact results. I shall speak in the following only of the sodium salts of the above compounds, as it will make the explanation clearer.

Let us assume, first, that we have only a mixture of sodium hyposulphite and sulphite, free from sulphate, in solution. If, on the one hand, we estimate how many grammes of iodine are required by an aliquot part of the mixture—acidulated with acetic acid—to yield the well known final blue reaction with starch; and if, on the other hand, we find how many grammes of sodium sulphate an equal measure of the mixture yields on perfect oxidation with chlorine or bromine, all the data necessary for the calculation of the respective quantities of hyposulphite and sulphite are in our possession, and we can form two equations from which both the unknown quantities x_1 and y_1 can easily be calculated.

Let x_1 = grms. iodine corresponding to $Na_2S_2O_3$ present.
Let y_1 = grms. iodine corresponding to Na_2SO_3 ,,
Let A = the quantity of iodine which the unit requires for testing with starch.
And B = grms. Na_2SO_4, which the unit yields on perfect oxidation,

Then—

$$x_1 + y_1 = A$$

$$\frac{2Na_2SO_4}{Na_2S_2O_3} \cdot \frac{Na_2S_2O_3}{I} \cdot x_1 + \frac{Na_2SO_4}{Na_2SO_3} \cdot \frac{Na_2SO_3}{2I} \cdot y_1 = B.$$

Or—

$$\frac{2Na_2SO_4}{I} x_1 + \frac{Na_2SO_4}{2I} \cdot y_1 = B.$$

Which gives us—

$$x_1 = \frac{2I}{3Na_2SO_4} \cdot B - \tfrac{1}{3}A.$$

$$y_1 = \tfrac{1}{3}A - \frac{2I}{3Na_2SO_4} \cdot B.$$

To get the result as grms. $Na_2S_2O_3$ and Na_2SO_3 it is only necessary to multiply x_1 by—

$$\frac{Na_2S_2O_3}{I}, \text{ and } y_1 \text{ by } \frac{Na_2SO_3}{2I}.$$

From this we find x = grms. $Na_2S_2O_3$ =

$$\frac{2Na_2S_2O_3}{3Na_2SO_4} \cdot B - \frac{Na_2S_2O_3}{3I} \cdot A =$$

$$= 0{\cdot}741784\,B - 0{\cdot}414698\,A.$$

y = grms. Na_2SO_3 =

$$\frac{2Na_2SO_3}{3I} \cdot A - \frac{Na_2SO_3}{3Na_2SO_4} \cdot B =$$

$$= 0{\cdot}661417\,A - 0{\cdot}295775\,B.$$

Care must of course be taken that the dilution while titrating is sufficient, and at least two titrations ought to be made.

If besides hyposulphite and sulphite sulphate is present, it is necessary to estimate this by itself, and the Na_2SO_4 thus found subtracted from the total Na_2SO_4 is B. As long as there is no sulphide present this can be done in the following manner:—The liquor to be examined is heated in a flask, and carbonic acid passed through till all the air is expelled. Then hydrochloric acid is added in excess, and the liquid boiled down in a CO_2 atmosphere to one-fourth of its volume. After filtering, it is precipitated with barium chloride as usual.

0·21385 grms. Na_2SO_4 were mixed with a very great excess of $Na_2S_2O_3$ and Na_2SO_3, and yielded, after being treated as described above, 0·2151 grm. Na_2SO_4. If sulphide is present this must be got rid of by means of cadmium carbonate before starting the analysis.

A mixture was prepared, containing per unit,—

Na_2SO_4	0·4165 grm. =	39·06
$Na_2S_2O_3$	0·3946 ,,	37·01
Na_2SO_3	0·2551 ,,	23·93
	1·0662	100·00

And the following data got—

Total Na_2SO_4	1·4174 grms.
Actual Na_2SO_4	0·4165 ,,

Therefore B = 1·000900
A = 0·833189.

From which we calculate—

Na_2SO_4	0·4165 grm. =	38·98
$Na_2S_2O_3$	0·3969 ,,	37·15
Na_2SO_3	0·2550 ,,	23·87
	1·0684	100·00

I have used this method with great advantage in the analysis of intermediate as well as final products in the manufacture of soda-ash and caustic soda.

"*Note on the Action of Iodine Trichloride upon Carbon Bisulphide*," by J. B. HANNAY, F.R.S.E., F.C.S.

It is stated by Weber that when iodine trichloride is added to carbon bisulphide a new product is formed. Now I have examined the action of these two substances upon each other, and find it is according to the following equation:—$2CS_2 + 3ICl_3 = CCl_4 + CSCl_2 + 3SCl + 3I$.

On adding carbon bisulphide to pure iodine trichloride till it was all decomposed considerable heat was evolved, and on cooling iodine crystallised out. A qualitative examination of the liquid showed the presence of sulphur chloride in large quantities, and on decomposing this with water, the characteristic smell of the sulpho-chloride of carbon was observed. This was further recognised by its deportment with alkalies, and after its removal from the liquid, the tetrachloride of carbon was easily recognised by its peculiar sweet smell, strongly reminding one of the smell of primrose leaves.

A weighed portion of the trichloride was heated with the requisite amount of carbon bisulphide to convert it into the above products, when it was found there was neither an excess of carbon bisulphide nor of the trichloride present. The liquid was allowed to cool, and when all the iodine had crystallised out, it was passed through a small filter of asbestos, and washed with a few drops of carbon tetrachloride. The iodine on the filter was estimated, and gave only a little under the required amount. The filtrate was then treated with caustic potash, and the separated carbon tetrachloride weighed after transference to a tared bulb. The sulphur in the liquid, left after removal of the tetrachloride of carbon, was oxidised by means of potassium chlorate and strong nitric acid, and estimated as barium sulphate.

The following table gives the figures which were obtained on working with 10 grms. of iodine trichloride, and also those deduced from the above equation:—

	Found.	Calculated.
CCl_4	2·05	2·198
$CSCl_2$	1·71	1·641
CS_2Cl_2	2·90	2·890
I	5·37	5·428

Specific Heat of Beryllium (Glucinum).—L. F. Nilson and O. Petterson.—The specific heat of glucinium is 0·4079. It belongs not to the magnesian but to the aluminium group of metals, and glucina is a sesquioxide. —*Ber. der Deut. Chem. Gesell.*

NOTICES OF BOOKS.

Food; some Account of its Sources, Constituents, and Uses. By A. H. CHURCH, Professor of Chemistry in the Agricultural College, Cirencester. Published for the Committee of Council on Education by Chapman and Hall.

THIS treatise forms one of the "South Kensington Museum Science Handbooks," and is, as we learn from the preface, in the first place, intended for the instruction of those visitors to the Bethnal Green Museum who may wish to study the collection of food-products there displayed, and secondarily for the benefit of persons who have no facilities for inspecting the specimens there displayed. Both these purposes seem to us to have been very fairly accomplished. The medical practitioner or the chemist will not indeed find much with which he was not already acquainted. No novel views are brought forward, and the author's original work—which has certainly been considerable—has been chiefly undertaken with a view of checking the commonly received composition of various articles of diet. On the other hand, the British public, even the "respectable and intelligent portion," will find here not a little useful information of which it is too commonly ignorant to its loss and to the emolument of quacks and pretenders. It may open the eyes of some people who feed their young children upon so-called "corn-flours," to be told that "these products are not flour, but nearly pure starch, and that they contain mere traces of bone-forming and flesh-forming materials." All this, it is true, has been said before, but in a work like the present, prepared at the request of the Committee of Council on Education it will, perhaps, carry the needful authority. In 1 lb. of "corn-flour" the author found only 18 grains of flesh-formers, whilst in the original maize there are 1 oz. 193 grains, or 35 times as much! Yet John Bull is found willing to buy the deteriorated article at a higher price. The preparations of lentils, also sold at enormous prices under fanciful names, do not escape the author's scrutiny. The following passage also is highly satisfactory:—"In order that coffee may be enjoyed in perfection, not only must it be free from admixture with the cheap and miserable adulterants commonly stated to improve its taste, but it must be freshly roasted to the right extent, freshly ground, and so made into a beverage that its soluble constituents are extracted without its aroma being dissipated." Concerning Paraguay tea, or maté, which some persons are striving to bring into common use in Europe, Mr. Church remarks that it does not yield a wholesome beverage fit for habitual use. "It acts upon the nervous system mainly, but it affects the digestive tract (!) also, and often injuriously."

The author's condemnation of so-called British wines as "not generally wholesome" is very just, as far as regards those ordinarily manufactured for sale, especially if prepared from rhubarb, a vegetable whose very questionable action on the human system is not atoned for by any delicacy of flavour. But we have met with current-wine over twenty years in bottle, and perfectly free from "fortification," in which a very fine bouquet had been developed. The fact that the other vegetable acids, unlike the tartaric, are not separated out in the form of sparingly-soluble salts is doubtless condemnatory of any fruit or stalk containing oxalic acid, but it is of much less importance where the citric and malic only are present.

We regret to find here no reference to the great superiority of the fruit-vinegars over those prepared from malt or from starch. Apple-vinegars are in very extensive use in the United States, and preserve the delightful aroma of the fresh fruit.

As regards nitro-benzol, sometimes improperly used instead of oil of bitter almonds, the author very properly points out that it is not merely poisonous, but has a much less agreeable odour and taste than the true oil. Nor does he consider it proved that the artificial fruit-essences are really identical with the natural flavours which they closely simulate. We have known instances of alarming symptoms following upon a very moderate dose of so-called "Champagne cider," in the concoction of which no apples had been employed. The unpleasant effects of many samples of raspberry cordial and raspberry vinegar, commonly ascribed to magenta, supposed to have been used in giving a factitious colour, are, according to Dr Reimann, very possibly due to the essence employed to simulate the flavour of the raspberry. Artificial vanillin, Mr. Church observes, is not a mere imitation of the natural product, but is absolutely identical therewith. Our author's estimate of Liebig's extract of meat agrees with that of most recent authorities. It is a stimulant and flavourer rather than a substantive food. In the foods for infants prepared from farinaceous matters by converting their fecula into dextrin and glucose there is often a deficiency of flesh-formers, and we have heard from medical friends of not a few instances where their prolonged use has led to disastrous consequences. It is, if we may use the expression, a curious whim, that while the human infant, like the young both of mammalia and of most birds, requires and receives at first an exclusively animal diet, yet when weaned it is too often put upon an exclusively vegetable regimen sadly deficient in blood-forming ingredients.

We hope that Mr. Church's work will be widely read, and that its teachings will be acted upon.

Plain Words about Water. By A. H. CHURCH, Professor of Chemistry in the Agricultural College, Cirencester. Published for the Committee of Council on Education. Chapman and Hall, Piccadilly.

WE have here a useful little treatise, calculated to be of great public service. The author speaks in the first place of water as forming part of the human body, as well as in plants and animals generally, and explains its physiological functions. He then turns to the proportion of water present in certain articles of daily food, which he illustrates by a diagram. An examination of our water-supply next follows. Mr. Church explains the dangers of river-water if used for domestic purposes, and the still greater risk attending the consumption of a supply from shallow wells. He gives a sectional diagram of a well sunk in a gravelly soil down to the clay, rock, or other more impermeable substratum, and in friendly proximity to the cess-pool, an interchange of liquid taking place between the two according to its temporary height in each. As an instance in point, he mentions that a well which supplied several cottages with water suddenly failed. On examination the reason was soon discovered: the owner of an adjoining house had cut off the supply from a water closet, and substituted an earth-closet. In all this account of shallow wells and their feeders there is nothing in the least sensational or exaggerated. In country places we have repeatedly observed the well serving for a row of cottages separated from the cesspool merely by three or four yards of gravel or chalk, sufficient indeed to remove visible impurities and confer a delusive appearance of brightness, but utterly unable to remove dissolved impurities or those minute organisms which are supposed to convey cholera and typhoid fever. The author does not think it likely that Thames water, however filtered, and however guarded from known and divertible impurities in the upper parts of the river, can become a satisfactory source for the greater part of London.

The remainder of the work is devoted to a description of the means of testing waters, and of purifying such as are more or less charged with foreign matter. As he is addressing himself not to professional men but to the British public at large, he does not, of course, enter into quantitative methods, but recommends the application of

a few simple qualitative tests, such as nitrate of silver, molybdate of ammonia, permanganate, Nessler's liquid, along with a careful observation of the colour, transparency, and odour of the water.

A Hand-book of Volumetric Analysis. Designed for the use of Classes in Colleges and Technical Schools. By Edward Hart. New York: J. Wiley and Sons. London: Trübner and Co.

Like every other subject connected with chemistry, volumetric analysis is made the subject of no small number of treatises and manuals. The work before us, though calculated to be useful to students, does not present any broadly characteristic feature. The author describes first the instruments used, then points out certain sources of error too often overlooked, and passes next to the preparation of standard solutions. The volumetric methods are then described under the three heads of saturation, oxidation or reduction, and precipitation. In addition to the metals, processes are given for the volumetric determination of the ordinary organic acids, such as oxalic, acetic, formic, tartaric, &c., as also for sugar, phenol, the compound ethers, chloral hydrate, urine, and indigo. For the latter substance he recommends the permanganate process, admitting, however, that it is not free from objections. For the determination of tannin, a question which may almost be called an opprobrium of technical analysis, the author gives the raw hide method of Hammer, and Löwenthal's permanganate process. He quotes the statement of Oser, that 1 c.c. permanganate = 0·006236 grm. oak-bark tannin, and that of Neubauer, that the same volume represents only 0·004155 grm. of the tannin of gall-nuts. Hence either different varieties of tannin are not mutually comparative, as Löwenthal himself holds, or the termination of the process is not sufficiently well defined.

For the determination of free oxygen in water—a favourite method in France for ascertaining its comparative impurity—the author recommends the process of Schützenberger and Risler, the use of hydrosulphite of sodium with Coupier's blue as an indicator. We regret much that certain modern authorities on chemical nomenclature have given to Schützenberger's "hydrosulphite" the name "hyposulphite."

Elements of Chemistry; Theoretical and Practical. By W. A. Miller, M.D., &c., late Professor of Chemistry in King's College, London. Revised by Herbert McLeod, F.C.S., Professor of Experimental Science, Royal Indian Engineering College. Part I., Chemical Physics. Sixth Edition. Longmans and Co.

Dr. Miller's work has become so widely and favourably known during the two and twenty years that it has been before the public as to render criticism superfluous. The present edition appears to have been carefully revised in accordance with the most recent researches; the references have been verified, and all tables and other numerical matter re-calculated.

How to Work with the Spectroscope; a Manual of Practical Manipulation with Spectroscopes of all kinds. By John Browning, F.R.A.S., F.R.M.S., &c.

This little book contains descriptions and figures of most of the great variety of spectroscopic apparatus now in use, for the construction of which the author has deservedly become famous. The construction of each instrument is briefly, yet clearly, described, and a somewhat detailed account given of the way of using it, either by itself, or when needed, in combination with the telescope or microscope.

Spectroscopes, like many other instruments, are now constructed in so many ways, and used for so many purposes, that even persons accustomed to scientific instruments sometimes feel at a loss, when a new instrument comes into their hands; to such Mr. Browning's directions will be of great service, and of still more use to those who, without any previous experience, and probably unaided, are commencing spectroscopic investigations.

Full directions are also given for the management of the electric light, and the exhibition of spectra upon a screen. Also the methods of constructing spectrum maps with the various instruments contrived for that purpose.

CORRESPONDENCE.

THE EUDIOMETRIC ANALYSIS OF MIXTURES OF PARAFFINS.

To the Editor of the Chemical News.

Sir,—Messrs. Morton and Geyer, in their paper on "Water Gas" in the Chemical News (vol. xxxvii., p. 187), fill a whole column with mathematical formulæ in order to prove that it is not possible to ascertain the proximate composition of a mixed paraffin by means of eudiometric analysis. I wonder how they managed to get through all this laborious calculation without seeing that the same result may be arrived at by two lines of common-sense reasoning.

A paraffin, as the general formula C_nH_{2n+2} shows, contain x in every one standard volume (*i.e.*, in the volume of H_2) the elements of one molecule of hydrogen, H_2 + the elements of an olefine, C_nH_{2n}, and the same is the case with any *mixture* of paraffins; because, whatever may be the names of the individual paraffins which are mixed together, we always have H_2 per standard volume + something of the composition C_nH_{2n}, although of course the "n" is not in general an integer. Hence, the elementary composition of a mixed or simple paraffin C_nH_{2n+2} is *completely determined* when we have ascertained the "n," *i.e.*, the number of volumes of carbon vapour contained in 2 volumes; and supposing even the n to turn out an integer the gas may nevertheless be a mixture. For a gas containing n volumes of C per 2 vols. may be produced in an infinite variety of ways by mixing together hydrogen or lower paraffins with higher paraffins (even by twos), and the mixture, as we saw, is always bound to contain C_xH_{2x+2} per 2 vols.

What I have just tried to explain may easily be expanded into a larger proposition, of which I wonder that it is nowhere explicity stated, except in my own article "On Gas Analysis" in the new "Handwörterbuch."

Supposing we knew a gas to contain $C\alpha H\beta N\gamma O\delta$ per 2 vols., and it is clear that from this formula we might calculate out *all* the data that the eudiometric analysis of the gas could possibly bring out. Hence, conversely, if the data are given it is impossible to extract from *them* anything over and above the formula, *i.e.*, the elementary composition of unit volume.

The very general custom of reducing the data of the eudiometric analysis of even highly complex combustible gas-mixtures which are not susceptible of *actual* analysis to imaginary percentages of C_2H_4, C_3H_6, &c., &c., is only a clumsy mode of stating that the gas contains so and so much C, H, O, &c., per 100 volumes. Why not give these percentages themselves in plain figures?—I am, &c.,

W. Dittmar.

Anderson's College, Glasgow,
May 11, 1878.

ANALYSES OF STEEL.

To the Editor of the Chemical News

Mr. Sergius Kern publishes in your journal of the 24th inst. a series of analyses of steel, in which the sulphur and phosphorus are given in most cases as *nil*, some as a

trace, and in some cases only does he give phosphorus and sulphur, the highest estimation of phosphorus being 0·03 per cent.

My experience (a very extensive one) in the examination of steel—certainly all English made steels used for axles, rails, plates, tyres, &c.—is that it universally contains a weighable amount of phosphorus, and only in very rare instances are such steels free from sulphur. Swedish iron, also, as a rule contains a weighable amount of phosphorus; only in exceptional cases do I find even traces. Am I to understand that the steel examined by Mr. Kern is exceptionally pure? Were I to express an opinion, I should say that his methods of analysis are at fault, and certainly not adapted to detect small quantities of sulphur and phosphorus. I would also observe that the manganese determinations are all unusually low, and I think it is more than probable a similar cause may account for this.—I am, &c.,

EDWARD RILEY.

London, May 27, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 16, April 22, 1878.

Second Note on the Vision of Colours.—E. Chevreul.—The athor treats of the influence of his laws of the simultaneous contrast, the successive contrast, and the mixed contrast of colours, and gives instances of their application. He mentions that if grey or white designs are to be produced upon a coloured ground it is necessary to add to the grey or the white a trace of the colour of the ground to prevent the appearance of its complementary colour. In an experiment with revolving discs painted half smoke-black and half white, the colours being divided by a diameter, on rapid motion the whole appeared of a uniform grey, but on slow motion the white took a yellow shade with a cast of red, and rising from the 1st to the 7·5th, and even to the 8th tone, whilst the black certainly took a blue-violet shade.

Researches on the Action of Dried Oxalic Acid upon the Primary, Secondary, and Tertiary Alcohols. MM. Cahours and Demarcay.—The action of dry oxalic acid upon the tertiary alcohols, which consists in resolving them into hydrocarbides and into water which combines with the oxalic acid, establishes a very well-defined distinction between these compounds and the primary and secondary alcohols; both the latter being under similar circumstances transformed into oxalates. Similar results might doubtless be obtained by causing dry oxalic acid to act upon the so-called pseudo-alcohols.

Results of Eperiments made in Various Parts of Algeria on the Industrial Application of Solar Heat.—M. Mouchot.—The author has first endeavoured to ascertain what metals are best adapted for reflectors. He gives the preference to brass, upon which a thin layer of silver has been deposited by galvanism. The daily variations of heat, with a clear sky, are not very sensible between 8 a.m. and 4 p.m. The intensity of the heat collected is satisfactory between 6 a.m. and 7 a.m.; it increases rapidly from 7 p.m. to 8 p.m., and decreases between 4 p.m. and 6 p.m. The quantity of heat collected at Algiers per minute per square metre was 7 calories in April, 8 in May, and 8·5 in June and July. A yield of 7 calories proves that a reflector of a square metre would boil in less than 12 minutes a litre of water at 20°, and give hourly 1322 litres of steam at the normal pressure. These results are only two-thirds of what may be attained with receivers of larger size. The author thinks that he has succeeded in popularising the small solar apparatus suited for cooking food, baking bread, distilling alcohol, &c.

Observations Relating to the Paper of MM. Moitessier and R. Engel upon Chloral Hydrate.—L. Troost.—The author shows that the observations of MM. Moitessier and Engel furnish no argument against the existence of chloral hydrate in the state of a definite gaseous compound, distinct from a mixture of its elements, water and chloral.

Formation of Metallic Arsenides.—A. Descamps.—On attempting to prepare metallic arsenides by submitting arsenites or arseniates to the reducing action of hydrogen, carbonic oxide, or coal-gas, the author obtained very imperfect results. He also reduced arseniates in a crucible with potassium cyanide in excess, so as to form a liquid layer which might preserve the compound from the action of the atmosphere. In these experiments he continued the application of heat till arsenical vapours no longer escaped. With many metals, however, arsenic does not form absolutely definite compounds, but alloys, which, after being heated for a certain time, may lose arsenic and change their composition. He has also prepared arsenides by the direct action of metallic arsenic upon the metal in a current of hydrogen, or, preferably, by heating the metal in a crucible along with excess of arsenic and borax as a flux. The arsenides of copper, gold, and silver have been prepared by placing metallic arsenic in solutions of copper sulphate, silver sulphate, or gold chloride.

Determination of Natural Tartrate of Lime in Crude Tartars.—A. Scheurer-Kestner.—Tartars, lees, &c., are essentially composed of potassium bitartrate, with which calcium tartrate is often mixed. For the determination of the potassium bitartrate a standard alkaline liquid is generally caused to act upon a hot solution of the sample in water. But it has been found that this process leads to exaggerated results. Certain tartars, and especially certain lees, contain acid substances of the nature of tannin, which act upon litmus paper and consume the alkaline liquid just as potassium bitartrate would do. To obtain exact results it is therefore necessary to ignite the sample, and determine the potassium in the residue by means of a standard acid. The determination of calcium tartrate is often made by dissolving the sample of tartar in hydrochloric acid, and precipitating with caustic soda. This method gives satisfactory results if the specimen to be analysed is free from calcium sulphate. In the contrary case the numbers found are always erroneous, the error being proportionate to the quantity of gypsum present. It is known that calcium sulphate, in presence of an alkaline solution of a neutral tartrate, is converted into neutral calcium tartrate, whilst the alkaline base combines with the sulphuric acid. The reaction is so complete that in certain works it is used for the preparation of calcium tartrate for the formation of tartaric acid. At the moment when the hydrochloric solution of the tartar is neutralised, in order to precipitate the calcium tartrate, the most favourable conditions are obtained for the formation of this body at the expense of the calcium sulphate, and if there is gypsum in solution, as often happens, the quantity of calcium tartrate obtained by no means represents the amount actually present, but is augmented in equivalent proportions. Some authors have recommended the following process:—Calcination of the tartrate to be analysed, when the tartrates and bitartrates are converted into carbonates. The potassic carbonate is dissolved in water, and shows on titration the quantity of bitartrate originally present. The calcium carbonate remaining on the filter shows, in like manner, the value of the pre-existing calcium tartrate. But this process, though accurate when the tartar is free from gypsum, is otherwise defective. Hence the following method is to be preferred:—The sample is dissolved in hydrochloric acid, the filtered solution is neutralised with

caustic soda, and then precipitated with calcium chloride. All the tartaric acid is precipitated as calcium tartrate. The precipitate is washed, calcined, and the calcium carbonate obtained is titrated in the ordinary manner. If the tartar has been previously titrated with a standard alkaline liquid it is easy, from these two data, to calculate the respective quantities of potassium bitartrate and calcium tartrate; but this is only possible when the sample is free from other acid products.

On Normal Methyl-oxybutyric Acid and its Derivatives.—E. Duvillier.—This acid is a slightly oily liquid, soluble in water, alcohol, and ether, and has an acid and sweet taste, and a strong acid reaction. Its composition corresponds to the formula $C_5H_{10}O_3$.

On a New Mineral discovered by Mr. Lettsom.—M. Lecoq de Boisbaudran.—Mr. Lettsom, having formed a collection of English specimens of blende to be sent to the author for the detection of gallium, found that certain Cornish specimens in the Oxford collections were not blende at all, containing neither zinc nor sulphur, but were composed essentially of didymium and erbium phosphate. Mr. Lettsom has given this mineral the name of Rhabdophane. Its exact locality is not known.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 16, April 18, 1878.

The Fumivorous Furnace.—M. Dufour.—This new furnace is reported to be completely successful both in the prevention of smoke and in the economy of fuel. At Compiegne it was adapted to an ordinary boiler 7 metres in length. The evaporation without the "fumivore" was 4·16 litres of water per kilo. of fuel, whilst with the fumivore it rose to 12·11 litres.

No 17, April 25, 1878.

The salts of potassium, copper, cobalt, and magnesium are found by MM. Joliet and Lafont to be muscular poisonous, and to interfere with the movements of the heart. The salts of sodium do not share this property.

Reimann's Färber Zeitung,
No. 16, 1878.

Alkalimetric Indicator.—W. v. Miller proposes the colour tropeolin, discovered by O. Witt, and manufactured by Williams, Thomas, and Dower, of Brentford, as an indicator for the presence of an acid in volumetric analysis. Yellow tropeolin (No OO) turns at once to a crimson red in an acid liquid. This indicator is especially adapted for the titration of soda-ash as it is not affected by carbonic acid, which consequently does not require to be expelled by boiling.

No. 17, 1878.

Anhydrous sulphuric acid is now manufactured on a commercial scale in Bohemia, and is sold in tin cases, which appear not to be attacked by the acid. It is chiefly used in the manufacture of artificial sulphuric acid.

Berichte der Deutschen Chemischen Gesellschaft,
No. 4, March 11, 1878.

Oxidation of Aluminium.—Carl John.—The author finds that aluminium amalgamated with mercury, steeped in water acidulated with sulphuric acid, and then taken out and dried, becomes subsequently covered with a white coating of alumina, among which globules of mercury are perceptible.

On Mono-nitro-pyro-catechin.—Rudolf Benedikt.—This compound, $C_6H_3(NO)(OH_2)$, crystallises in minute needles, dissolves readily in water, alcohol, and ether, but sparingly in benzol. It fuses at 157°; at higher temperatures it is decomposed, burning with a sooty flame, and leaving much charcoal. It dissolves in potassa-lye with a splendid purple colour, a reaction so sensitive that it may serve as an excellent indicator in titrations.

MISCELLANEOUS.

The Institution of Civil Engineers.—The *Conversazione* of the President, Mr. J. F. Bateman, F.R.S., will be held on Monday, June 3, at the India Museum, South Kensington, by permission of the Secretary of State. The change from Tuesday to Monday has been made on account of the 3rd of June being the fiftieth anniversary of the grant of the Royal Charter of Incorporation, which will thus be appropriately celebrated. The party will be exclusively for gentlemen, as in the time when the gathering took place at the rooms of the Institution.

Mr. William Baker, of Sheffield.—In our issue of May 3 we referred to an alarming accident which had befallen Mr. Baker, and which it was feared must prove fatal. Our readers, especially those who know Mr. Baker, will be glad to hear that he is now making satisfactory progress towards recovery. The fracture of the skull has healed up, and, although he was at first totally blind, he can now see sufficiently well to make it probable that his sight will be restored. We trust that we may soon have the satisfaction of announcing that Mr. Baker has quite recovered. A long time must, however, elapse before he will be able to resume the duties of his profession.

MEETINGS FOR THE WEEK.

MONDAY, June 3rd.—Royal Geographical, 8.30.
—— Royal Institution, 3. General Monthly Meeting.
TUESDAY, 4th.—Royal Institution, 3. "Minute and Low Forms of Life," Rev. W. H. Dallinger.
—— Zoological, 8.30.
WEDNESDAY, 5th.—Geological, 8
—— Microscopical, 8.
THURSDAY, 6th.—Royal Institution, 3. "On Molecular Physics: Gases," Prof. Guthrie.
—— Royal 8.30.
—— Royal Society Club, 6.30.
—— Chemical, 8. "Analogies between the Action of the Copper-zinc Couple and Occluded and Nascent Hydrogen," Dr. Gladstone and Mr. Tribe. "On the Alkaloids of the Aconites," Part III., Dr. Wright and Mr. Luff. "On the Alkaloids of *Veratrum Sabadilla*," Dr. Wright and Mr. Luff. "On the Action of Hydrochloric Acid on a Variety of Compounds," J. W. Thomas. "The Action of Oxides on Salts," Dr. Mills and Mr. Wilson. "A New Test for Glycerin," A. Senier and A. J. G. Lowe. "Ammonium Tri-iodide," G. S. Johnson.
FRIDAY, 7th.—Royal Institution, 8, Weekly Meeting. "Romanticism," Mr. W. H. Pollock, 9.
—— Geologists' Association, 8.
SATURDAY, 8th.—Royal Institution, 3. "On Joseph Addison," Prof. Henry Morley.
—— Physical, 3.

TO CORRESPONDENTS.

Saccharine.—We have several letters waiting for you at our office. Please forward your present address.

Just completed, a few copies of

FARADAY'S EXPERIMENTAL RESEARCHES IN ELECTRICITY (1839-55), 3 vols., 8vo., with 16 plates, cloth, £2 8s.

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Copies have lately sold for seven and eight guineas: the above should therefore be secured at once before the price rises again.

BERNARD QUARITCH, 15, Piccadilly, London.

THE CHEMICAL NEWS.

VOL. XXXVII. No. 967.

COLOUR-COMPARATOR FOR QUANTITATIVE ANALYSES.

By Professor ALBERT R. LEEDS.

THERE are numerous chemical operations in which it is required to estimate the amounts of substances in solution by the relative depth of tint of a certain colour. Various methods of so doing have been resorted to, some involving considerable instrumental complication in the way of lenses, graduations, and rack and pinion movements. Without describing these more particularly here, it will be sufficient to say that the apparatus herein described was arranged with a view of dispensing with all lenses or with graduations which could not be executed by the chemist himself.

It was designed, moreover, to permit of the comparison of a large number of liquids at the same time and in the same vessels in which the various operations upon them had been originally performed.

It is a rack, about 16 inches wide, and of about the same height. The materials employed have been tin, sheet brass, or, in the latest and most perfect forms, of a combination of iron and brass castings. It is arranged to hold 10 comparison tubes, each of which, when filled to the same depth (6 inches), contain precisely 100 c.c. An adjustable mirror reflects the light downward, through these comparison tubes, and the light, after passing through slits ($\frac{1}{8}$ of an inch long and $\frac{1}{4}$ inch wide), cut in a stage beneath, is reflected outward to the eye by a similar adjustable mirror. In the apparatus figured the supports of the upper mirror are placed at the front corners, so as to make the axis of the mirror in front of the upper row of holes, and permit the tubes to be lowered into their places from the top. Later, it was found more convenient to slip the tubes in from below, which can be done without rising from one's seat, and in this case the axis of the mirror was put directly over the centres of the line of holes, and the mirror made somewhat narrower (3 inches). A black cloth, not shown, hung from the back upper corners, prevents any light reaching the eye except that reflected from the lower mirror.

The comparison is effected by a prism nearly filled with a suitable coloured liquid. The prism is constructed by cementing within four straight walls of plate glass the inclined top and bottom sides of the prism. It is 10 inches long, $1\frac{1}{2}$ inches wide, $2\frac{3}{4}$ inches at the base of the prism, narrowing to $\frac{3}{16}$ inch at the apex. The prism is cut off in this manner at the apex, because when filled with liquid of the most suitable intensity of colour, the gradations beyond this point are too inconsiderable to be of value. The liquid is introduced through an orifice in the base, over which is afterwards cemented a glass cover.

It would be of great service if a little prism of about these dimensions were obtainable. This would permit of other than aqueous solutions being employed without detriment to the cement. And since it is desired to compare tints of colour only, slight irregularities in the thickness of the walls of the prism would not seriously interfere with its use. In making the comparison, the prisms may be either lifted to the right or left directly upon the stage, or placed upon a second movable stage, which rests upon the former and acts as a carriage. The prism is then moved out or in until the requisite shade of colour is arrived at. Considerable difficulty is also experienced in purchasing comparison tubes of uniform diameter, so that when equal amounts of liquid are introduced they will be filled to the same height. It is hoped that comparison tubes with flat bottoms can be moulded, which will prove satisfactory.

Employment of the Comparator in the Estimation of Ammonia.

Some difficulty was experienced in finding a comparison liquid, which would follow the tints given by the Nessler test, not only in very dilute, but also in more concentrated solutions of ammonia. It was found that neutral ferric chloride, potassium sulphocyanide, and nickel chloride, in proper proportions, gave identical tints, but the solutions decomposed on keeping. After many trials, in which the chlorides of gold and platinum and other salts were employed, with the admixture of colouring matters, and of similar mixtures with infusions of tea, coffee, &c., we finally succeeded in obtaining, with caramel solution and a small addition of aniline red, a satisfactory comparison liquid.

Method of Comparison.—Above the prism, in the comparator, a comparison tube with about 20 c.c. distilled water is placed. The comparison liquid is made of such strength that the light, after traversing its greatest depth in the prism, shall give a tint corresponding to 10 centi-

milligrammes of ammonia. An application scale is prepared once for all, by comparing the tints given by the prism with those given by known solutions of ammonia and the Nessler test, in 100 c.c. or 50 c.c. of distilled water placed in the comparison tubes. The readings are accurate within 0·005 milligramme of ammonia.

Quantitative Estimation of Colour in Potable Waters.

The method ordinarily employed is to fill cylinders of a certain diameter and depth with the same volumes of the waters under examination, and then by description terms to describe the tints as compared with one another and with distilled water. But as a general rule, these tints are not so far different from those which may be obtained by weak solutions of caramel, and these again from those imparted by the Nessler reagent to minute amounts of ammonia in solution, that a prism with a suitably arranged application scale may not be used in quantitatively estimating depth of tint in the colour comparator. Thus, on December 4th, 1877, the colour given by 100 c.c. of Passaic water in one of the comparison tubes more nearly corresponded to that communicated by the prism when shoved in to a point equivalent to 0·075 m.grm. ammonia than to any other point on the scale, and this figure might therefore be taken as expressing the tint of the water at that date.

If it were desirable to compare the tints of a large number of samples of water, and to express minute shades of colour, it would be desirable to fill a wedge with a correspondingly dilute solution and to graduate it by comparison with correspondingly minute amounts of ammonia.

Alkalinity or Acidity of Potable Waters.

The colour-comparator may likewise be employed advantageously to make a quantitative estimation of the degree of alkalinity or acidity of potable waters. This point in the analysis of drinking-waters does not appear to have attracted much attention, probably because these waters are, as a general rule, so nearly neutral that they do not react, alkaline or acid, with the tests in general use. In the *American Chemist* for March, 1874, I have called attention to the great sensitiveness of an alcoholic solution of alizarin in this respect, and proposed to employ it as a means of comparing the alkalinity of drinking-waters obtained from various sources. This may be done very rapidly by means of the colour-comparator. One comparison-tube is filled to the 100 c.c. mark with the water to be tested, and a second with water re-distilled until it has ceased to give any reaction for ammonia. 5 drops of alizarin solution are added to each, and then a centinormal soda solution run in, if, as is generally the case, the water reacts alkaline, until the liquid in both tubes has precisely the same tinge of red colour. The amount of alkali added may be taken as an index of the total alkalinity communicated by the various saline bodies held in solution. Thus, on April 30th, 100 c.c. of the Passaic water, as drawn from the laboratory hydrant, acquired the same tint, when alizarin was added to it until the colour no longer deepened, as 100 c.c. pure water to which the same amount of alizarin and 0·00068 grm. soda had been added. Of ordinary distilled water, c.c. was equivalent to 0·0003 grm. soda. This is not very far different from the amount which would be equivalent to the ammonia contained in ordinary distilled water, as determined by the Nessler reagent.

An attempt was made to substitute a solution of phenol-phthalein for alizarin in these estimations. But there was no perceptible reddening when phenol-phthalein, in amounts considerably greater than those which would correspond to the alizarin employed above, was added to similar samples. Phenol-phthalein is far less sensitive than alizarin, and for such purposes is inapplicable. In titrating with alkali, however, it has an advantage over alizarin in the following respect:—The latter changes very gradually through various shades of yellow-red to a red of different degrees of intensity. The red tint imparted by alizarin, therefore, does not mark the end reaction very satisfactorily, and it is safer to titrate back with acid until the red tint has disappeared. With phenol-phthalein the transition from a colourless solution, when a normal soda solution is added, to red is abrupt and positive. It is rather a matter of surprise to me that alizarin as an indicator in titrations, and for test-paper, has not come into general use: in this laboratory it has been in constant employment for the past three years.

Estimation of Combined Carbon in Iron and Steel with the Colour-Comparator.

It is well known that when iron and steel are dissolved in nitric acid the solution acquires a colour which is more or less brown in proportion to the amount of combined carbon present, and that a very ingenious method of carbon determinations was based by Eggertz upon this property. He obtained a standard tint by the solution of a sample containing a known amount of carbon, from which, by comparison of the depth of colouration, the percentages of carbon in other samples could be estimated.

His process has been variously modified, more especially by the substitution of a number of standard solutions, corresponding to various carbon percentages, in place of the one standard solution.* In this case, as the solution of the metal in acid does not preserve its tint for any length of time, the standard solutions are usually made of some colouring matter like caramel. A number of test-tubes are arranged in a convenient rack, and filled with solutions, beginning with a colour corresponding exactly with that produced by the solution of 1 grm. of iron containing 0·02 per cent of combined carbon in 15 c.c. of nitric acid of specific gravity 1·20, and ending with a colour corresponding to a similar iron dissolved in like manner, but containing 0·30 per cent of combined carbon.

Instead of a series of separate tubes, varying in colour by an amount corresponding to 0·02 per cent of carbon, it is proposed to use a prism filled with solution of caramel, or, as Britton has proposed, with a solution obtained by digesting roasted coffee in dilute spirit, and of such strength as will represent every percentage between the points most frequently to be determined. A 1 grm. of wrought-iron or steel, in which the percentage of combined carbon has previously been determined with great accuracy, is digested with 15 c.c. dilute nitric acid at 80° for half an hour. The residue is gently heated over a lamp with 5 c.c. fresh acid, the solution added to the main portion, and filtered through a small asbestos filter. From the filtrate a series of solutions is prepared, each reaching to the 50 c.c. mark in the comparison-tubes, and each exactly half the strength as the one preceding. These tubes are then placed in the comparator, and the points on the prism which transmit identical tints of colour are carefully noted, and transferred to an application-scale. 1 grm. of the sample to be analysed is dissolved in like manner, the filtrate made up to 50 c.c. in the comparison-tube, and then the prism is moved out or in until it gives the same tint of colour. The percentage, as marked on the application-scale corresponding to this point, is the percentage of combined carbon in the sample under analysis. If the percentage of carbon in the sample exceeds that indicated by the prism, a correspondingly less amount of the sample is to be brought into solution.

To illustrate the method the following details are given:—A prism 10 inches long, with a suitable caramel solution, was provided in the manner stated with an application-scale graduated from 0·00 to 0·24 per cent carbon. Upon a scale of this length, the intermediate percentages could readily be obtained by interpolation. The graduation was not carried higher than 0·24 per cent, because larger amounts of combined carbon gave tints of colour too deep to allow of slight differences in tint being recognised by the eye with certainty. A direct comparison with a series of steels, in which the amount of total carbon (column II.) had been determined by combustion, gave the following results (column I.):—

		Column I.	Column II.
Sample	I.	0·09	0·302
,,	II.	0·46	0·490
,,	III.	0·44	0·529
,,	IV.	0·62	0·649
,,	V.	0·72	0·801
,,	VI.	0·76	0·841
,,	VII.	0·80	0·867
,,	VIII.	0·86	0·870
,,	IX.	0·92	0·955
,,	X.	0·96	1·005
,,	XI.	1·04	1·058
,,	XII.	1·12	1·079

Without attempting to explain the discrepancies between these figures, the number of correspondences was thought sufficient to warrant the publication of the method, and to give the hope that with further trial it might prove rapid and accurate within the required limits. My thanks are due to my assistant, Dr. G. A. Prochazka, for his aid in making the foregoing determinations.

Stevens Institute of Technology, Hoboken, U.S.

* J. Blodget Britton, *Journ. Franklin Inst.*, [3], vol. lix., p. 356.

A STUDY OF PLAT-AMMONIA COMPOUNDS.

By SAMUEL E. PHILLIPS.

II.

If the cuprammoniums, the palladammoniums, and others, are first of all—

$$RH_3N,Cl,$$
then $$RH_6N_2,Cl,$$
or $$RH_{12}N_4,Cl,$$

with tri, penta, or other condensations, and with other normal and hybrid variations, then we may have succeeded in reducing the platinum series to one ordinary group, where pedantic classificatory divisions are not desirable in sight of the great *tout ensemble* of chemical philosophy so much desiderated.

In concluding a second attempt to that end, the reiteration has now been prompted by three collateral considerations which seem to fairly stand in close relation thereto:—

First. We have seen that with a certain or equivalent weight of platinum, varied or doubled only in the fifth series, ammoniacal condensations of 2N with 2Cl, 4N with 4Cl, and 8N with 8Cl, as alleged, precisely similar to the corresponding condensations of morphia and codeia, as embodied in the extended researches of Dr. Wright and others. If our resolution into the order and simplicity of law be valid in one case, may it apply equally to the other?

Secondly. We have seen a new series of plato-nitrates produced by the eminent and persevering labours of M. Nilson, and for which he has followed a fashionable routine in inventing new radicals for their interpretation. Again we say, may the same old principles and the same applications of electro law avail to the superseding of hypothetic radicals, for which there is no warrant either in sound theory or observed facts?

Thirdly. If the palladium analogues are found to conform with and to confirm the interpretation given of the platinum series, it might be well to glance at the general bearing, and reciprocal confirmation of all metal ammoniums generally.

In "A Study of Condensation Radicals" (CHEMICAL NEWS, vol. xxxi., p. 47) I endeavoured to reiterate and further exemplify the law of amine condensation; that they were one, and like all other condensed radicals; that while popular error believed in H_4N, H_8N_2, $H_{12}N_3$, &c., that both law and fact necessitated the progression H_4N, H_7N_2, $H_{10}N_3$, &c.; and my chief object was an earnest enquiry in regard to some few exceptions, and notably the morphia and codeia condensations of Dr. Wright, of which an extreme case might thus be contrasted:—

	Ordinary Octamine.	Dr. Wright.
Chloride ..	$H_{25}N_8,Cl$	$H_{32}N_8,Cl_8$
Acetate ..	$H_{25}N_8,O.AcO$	$H_{32}N_8,O_8.8AcO.$

Dr. Wright most kindly and genially defended his research, nor did I consider it fair or respectful to rush on a platform of equality with one so eminently superior in position and attainments; but it is important to note that he considered his interpretations as not exceptional, but justified by both law and fact, urging that "As a rule the maximum combining power of such bodies is normally equal to the number of N symbols in their rational formulæ; though a lesser acid combining power may be sometimes manifested, &c. The only poly-ethylen tetramines exhibit a maximum acid combining power of four, and so on."

In CHEM. NEWS (vol. xxxii., p. 1), "On the Monocharacter of the Ethylen and other Poly-amines," I endeavoured to show that all such bodies were normally mon-acid; urging that "this really is not a question of what may be, but of what the facts are, as derived from modern authorities holding the same views with Dr. Wright."

With declining powers I cannot hope to entertain any adequate investigation of those elaborate researches, extending to more than twenty memoirs, submitted to the Royal Society.

In the earlier stages the idea was that codeia was methyl morphia—

Codeia. Morphia.
$$C_{36}H_{21}O_6N + HI - MeI = C_{34}H_{19}O_6N,$$

but that practically morphia could not then be so obtained, as there was a tendency to assimilate 2H giving hydromorphia, $C_{34}H_{21}O_6N = X$, and that this was the subject of polymerisation.

Of these we select two typical cases, as illustrative of many others, with hydro-codeia and hydro-deoxymorphia, &c.:—

(A) is produced by $4X + 6HI$, and is represented as containing—

$$C_{136}H_{86}I_2O_{24}N_4.4HI.$$

As a normal *iodide* the elements would be thus:—

$$C_{136}\underline{H_{94}}O_{24}N,HI - = 5I.$$

(B) is produced by $4X + 7HI + 20HO$, &c. The idea being that these bases, acted upon with HI, indicate that they are "unsaturated" bodies, and capable of taking up several molecules of HO and HI; generally two equivalents for one of N.

This is substantially my own view of the case:—As quinon absorbs 2H, and becomes hydro-quinon, so it may under certain conditions pass through other stages up to the point of paraffin saturation, $C_{12}H_3$, $C_{12}H_5$, $C_{12}H_7$, $C_{12}H_9$, $C_{12}H_{11}$, and $C_{12}H_{13}$. And in the mechanism of these reactions with HI, it often happens that HH are replaced by HI.

In many cases this action takes place almost spontaneously; in others, it may require more exciting conditions; and it is also well known that the same conditions very often tend to a polymerisation of the radical.

The only difference between us is as to the *à priori* feeling in the distribution of these hydrations where substitutional ammonias are concerned.

Dr. Wright has a *hard and fast* rule, by which the outsiders follow the number of N equivalents, putting the rest in the radical or ammonium. I see no evidence whatever for that hypothesis, but am far from supposing a similar regularity of mono-appropriation, as suggested in *the normal iodide* above. On the contrary, I maintain that 2HCl, 2HBr, &c., very often represent the ordinary 2HO of a hydrate; and it may surprise some when I have completed the evidence for a new extension of hydrate law, as outside or apart from the radical oxide or iodide.

It is amusing to see Dr. Wright modestly hesitating—at one time wondering whether they be definite compounds or mere mixtures; at another time deploring the non-agreement of repeated analysis; and often finding amorphous tarry products, rather than definite crystals; yet, throughout all, endeavouring to apply the one *hard and fast* hypothetic rule. No botanist would waste his time in such bewilderment with hybrids; and in lieu of his lax method of appreciating free bases from the tetra- and other poly-iodhydrates, I would, for my part, only be satisfied with definite saltic derivatives.

Subsequent researches tend more and more to a doubling all the preceding notations. The hydrochlorate of tetra-codeia is a brownish brittle tar, and is of course an 8HCl body!

The action of HCl on the tri-codeia gives another body $-12HO$, that is $-2HO$ for every single codeia; and the many facts in this direction point irresistibly to the idea of weakly saltic dedoublements, such as we have referred to in the fifth series of platinum compounds:—

Morphia $-2HO$ = apo-morphia
Morphia $+2H$ = hydro-morphia.

Then we have oxy-morphia, deoxy-morphia, and other modifications of the type; and if we add to these chloro- and iodo-varieties of these several types, it becomes extremely feasible that under the forced conditions they should combine together, in weakly saltic dedoublements, to produce the supposed hexa- and octa-bodies under consideration.

In reply to S. E. Phillips, Dr. Wright cites the following proofs that morphia and codeia are 2N bodies:—

$C_{34}H_{37}ClN_2O_6$
$C_{34}H_{37}AcN_2O_6$
$C_{34}H_{36}BuAcN_2O_6$
$C_{36}H_{43}ClN_2O_6$.

But these prove nothing beyond the fact that all bodies may have their di-forms, and thus it is that Watts, on giving a list of oxy-morphia derivatives, ends with two hydrates:—

The mono- $=C_{34}H_{20}O_8NO.HO$
The di- $=C_{68}H_{39}O_{16}N_2O.HO$.

Of course they are notated very differently, but they have these normal elements, and their real purport is quite plain.

The di-acetyl, di-butyryl, and di-benzoyl derivatives of codeia and morphia, unite with 2 atoms of EI, mostly forming definite crystalline compounds, and, for aught that is known to the contrary, they may do so precisely as narceine and cotarnine do, and this mono-view is that which is most generally entertained.

It is easy to sit in judgment on profound researches; estimating things from another point of view, and judging superficially, to find fault; but whoever has time and ability to fairly appreciate must find a monument of labour, skill, and perseverance which goes far to redeem this country from the reproach of backwardness in original research.

But, with all the promptings of high admiration, I cannot estimate my point of view as *superficial*, and if similar tetra and octamin developments can be reduced to the simplicity of ordinary and mono-laws of combination, it does seem likely that a similar result may here also take place.

The Plato-nitrates.

M. Nilson, discarding the old view of these being double nitrites of Pt and other bases, evinces a lively fertility in the invention of new radicals on di- and tetratomic lines of construction; but he is little aware that old views may admit of a youthful renovation, and that, animated by the accessions of modern knowledge, they do not require the ordinary laws of combination to be overlaid by wanton hypothesis.

That the ammonium type is *one*, embracing nitric acid as one extreme, and ammonium in the other, is a modern fact, and triumph for old views, which will not be admitted until the underlying facts of atomicity can receive a better explanation than that ordinarily afforded.

Between O=8 and H or Cl, as between sodium and barium, there are differences of a marked character, which diatomic philosophy is incompetent to explain; nor can I feel any triumph therein, but must confess to a reluctant ignorance; but those who are freest from hypothesis may be expected to discern with more of simplicity the onward revelations of truth and new facts.

It is thus I would lay stress on the applications we have made of Pt replacing one H in ammonia; and our object is now to urge that the same may be said of O=8 or S=16 l

The odd and even ratios of O and H are very curious and instructive. Of NO or NH I know nothing as combining radicals, and of imide substitutions I am utterly sceptical.

NO_2 and NH_2 are both good and well known radicals of H equivalence, as seen in many nitroso or amido substitutions.

NO_3 and NH_3 are in no sense radicals; one is the nitroso-oxide of the nitrites, as the other is a hydride of amidogen, and possessing characters in common with all other hydrides.

NO_4 and NH_4 are definite and well known radicals, one of nitric acid the other of ammonium compounds, and both otherwise replacing H' in many and well-known ways.

Nor is this all; for between the two extremes there subsists every possible intermediate transition, not as exceptional facts, but fully paralleled in the analogous phosphines, arsines, and other ammonia types.

We have— PtH_3N
PtH_6N_2

Then why not— PtO_3N
PtO_6N_2

Suffice it to say that M. Nilson's extended series of plato-nitrates have exactly the elements thus pre-indicated—

$KO.PtO_6N_2O$

Of this series, the salts analysed have the very widest range, including all the cerite metals, as protoxide bases, and the sesqui-salts are equally normal in having 3 atoms of acid. They comprise a wide range like the corresponding sulphates—

$Al_2O_3.3SO_3$
$Al_2O_3.3PtO_6N_2O$, &c.

Of the General Character of the Metal Ammoniums.

On this occasion we only initiate a general review of these compounds, taking note of their more salient characteristics; and taking them in electro order, commencing with the most negative—

(1.) Gold is generally considered tri-atomic. Of its oxides and chlorides, we may have the proto- and di-forms, but it is most normally tri, *in relation to* O *or* Cl, and what alone concerns us in this connection is the undoubted fact of its mono-replacement of H.

HH_3N,Cl
AuH_3N,Cl
AuH_6N_2,Cl, &c.

(2.) and (3.) Of platinum and palladium, which are mono in the platinites, but most normally di in the platinates and palladiates we have the same mono-equivalence in substitution.

In treating of these, we omitted an important reference. It is alleged that "PtCl—called platinum dichloride ($Pt''Cl_2$)—absorbs 2 molecules of ammonia, forming platosammonia compounds ($N_2H_6Pt''Cl_2$); and $PtCl_2$—called platinum tetra-chloride ($Pt'''Cl_4$)—absorbs four molecules of ammonia forming platin-ammonia chloride ($N_4H_{12}Pt''''Cl_4$)."

That this is a deceptive expression of hypothesis, and *not of facts*, we hope to have made plain in the exceptional and *forced* conditions by which alone, the so-called platinamin or bichloride series can be produced.

It is a fact that both chlorides give *normal* results with ammonia, and that *both* when heated with excess of chlorine gas or strong nitric acid also give the abnormal bichloride or oxychloride derivatives.

(4.) Mercury, like platinum, has an extensive series of metal ammoniums, which may be studied under two aspects:—First. That of agreement with all the preceding, by which we have—

HH_3N,Cl,
HgH_3N,Cl,
HgH_6N_2,Cl, &c.

Secondly. A considerable range of discrepant combinations, which are outside our present limits, and which well demand a new and separate investigation. Our present *à priori* conviction being that, in common with copper, both elements are subject to allotropic variations of mono- and di-atomic weight, a principle exemplified in both mineral and organic chemistry.

(5.) and (6.) Ruthenium and iridium are both mono- and

di-atomic, and in so far conform to the platinic types; but that they are lower in the series, or less negative, is seen in this: that whereas Pt is very rarely sesqui, yet that intermediate type is much more predominant with these two metals, and they faintly introduce us to a new series of metal ammoniums, such as are predominant with the lower sesqui metals. Ruthenium gives some well-marked yellow salts of—

$$RhH_3N,Cl$$
$$RhH_6N_2,Cl,$$

both of which have been studied in their carbonates, nitrates, sulphates, and other good crystalline salts.

The deep golden-yellow diamine salts give off ammonia, and leave the lighter yellow salts of the simpler type. But the transition is best seen with iridium, which forms two distinct series. Like platinum we have—

$$IrH_3N,Cl,$$
$$IrH_6N,Cl, \&c.$$

With the corresponding sulphates, nitrates, &c., and a "nitrato-chloride" analogous to Gros's Pt salt, obtained by treating the chloride with strong nitric acid!

Like cobalt we have $(Ir_2Cl_2)H_{15}N_5,Cl$, of which the carbonate, nitrate, sulphate, and other salts have been prepared.

(7.) *Rhodium.*—The normal platinates are $KCl.PtCl_2$. The normal rhodiates, like many iridiates, $=3KCl.Rh_2Cl_3$, and hence the correspondence in the "ammonia rhodiums,"

$$[N_6H_{14}Rh_2'''(NH_4)_4]^{VI}.Cl_6 = \begin{matrix}(Rh_2Cl_2)H_{15}N_5,Cl.\\(Rh_2O_2)H_{15}N_5,O.\end{matrix}$$

The latter is a strong base, giving sulphate, oxalate, nitrate, and other crystalline salts; there is also a triamine form, and doubtless may be many others,—

$$(Rh_2Cl_2)H_9N_3,Cl.$$

(8.) *Chromium.*—The corresponding chromium-ammonia salts have been extensively produced in oxy, chloro, bromo, and iodo forms, and the tendency is apparently to tetramin bases:—

We have a bromide thus	$(Cr_2Cl_2)H_{12}N_4,Br$
A chloride	$(Cr_2Cl_2)H_{12}N_4,Cl$
A diamine nitrate	$(Cr_2O_2)H_6N_2,O.NO_5$
A mono-oxalate	$(Cr_2O_2)H_3N,O.C_2O_3$,

and others.

(9.) *Cobalt.*—It is here we have the fullest development of these metal ammoniums, and the varied interpretations they have received are at once both amusing and pitiable. As the platinum types—at any rate in their greatest simplicity—extend more or less to all metals, down to copper, zinc, and potassium, so cobalt is not excluded from that series. As such we have—

$$CoH_3N,Cl$$
$$CoH_6N_2,Cl$$
$$CoH_6N_2,O.SO_3$$
$$CoH_9N_3,O.NO_5, \&c.$$

These are formed when cobaltous salts are treated with varying proportions of ammonia and *protected from the air*. But they are easily oxidised, and thus give rise to what are called "peroxidised ammonia-cobalt salts," which are thus epitomised by Watts:—

Tetrammonia-cobaltic-chloride ..	$Co_2Cl_6.4NH_3$
Hexa-ammonia-cobaltic chloride ..	$Co_2Cl_6.6NH_3$
Octo- ditto ditto ditto (fusco)	$Co_2Cl_6.8NH_3$
Deca- ditto (reseo and purpureo)	$Co_2Cl_6.10NH_3$
Dodeca- ditto ditto ditto (luteo)	$Co_2Cl_6.12NH_3$

We hope to have refuted the hypothesis that in platammoniums, as in other ammoniums generally, the number of N equivalents determines the number of acid saltic constituents; but, strange to say, here is *another* hypothesis which totally misunderstands the oxy or chloro function in these sesqui compounds, representing the 6 atoms of chlorine as apart from the radical, and capable of replacement by so many atoms of acid!

On the contrary, we know that these sesqui bases can be well traced in their simple saltic forms, as also in their ammonia replacements, by 1 H. In the former, cobalt and uranium are most normally mon-acid, but have other variations,—

$$(U_2O_2)O.SO_3,$$
$$(Co_2O_2)O.SO_3, \&c.,$$

whereas other sesqui bases are most normally tri-acid, as in—

$$(Al_2O_2)O.3SO_3,$$
$$(Fe_2O_2)O.3SO_3, \&c.$$

A similar range of mono-, di-, and tri-acid behaviour seems to extend to the ammonia condensations where these sesqui-radicals replace 1 H: but whether due to any inherent tendency in the ammonia base or to the mechanism of production is not yet at all clearly understood.

It would not comport with the extreme brevity of this short notice to enlarge on the very extended cobalt series; suffice it to say that they appear to have three principal forms:—

(1.) The simple type corresponding with all other metal ammonias, from gold to potassium, CoH_3N,Cl, &c.

(2.) The sesqui types corresponding with those of iridium and chromium, $(Co_2O_2)H_9N_3,Cl$, &c.

(3.) A new series of "oxy-cobalt ammonias" studied by M. Fremy. As these differ from the second series by the uniform addition of O' or Cl', the inference is irresistible that they correspond to the platinum series of bichlorides or oxychlorides.

NOTE ON UREA AND CRENATE OF AMMONIA IN SPRING WATERS.

By Dr. T. L. PHIPSON, F.C.S., &c.

THE method by which urea can be discovered in the canal waters of Rotterdam and other places, has been also applied by me, in some instances, to detect crenic acid. I have found, in fact, that this method is liable to be interfered with, unless urea is present in considerable quantities, by the presence of crenate of ammonia, and that it can also be used to isolate crenate of ammonia in some waters which contain that substance in notable quantity and no urea.

It consists in evaporating about a quart of the water at a moderate temperature, making use of a water-bath, and treating the dry residue with absolute alcohol. The alcoholic solution being likewise evaporated to the state of a thick syrup, a minute quantity of this is placed upon the glass slide of the microscope with a drop or two of strong nitric acid. As soon as the liquid has been dried up by the aid of moderate warmth, the slide is examined with a low power, when the crystals of nitrate of urea (if urea is present) are easily distinguished. Occasionally they can be detected with the naked eye. This was the case with some water from the Knightsbridge Barracks, examined by me several years ago, of which one quart gave about 2 drachms of a yellow liquid having all the characters of urine.

In applying this method again recently to a well-water at Roehampton, in the county of Surrey, the alcoholic solution consisted entirely of crenate of ammonia. This water gave 35 grs. of solid matter (at 100° C.) per imperial gallon, composed as follows:—

Sulphate of lime	4·13
Carbonate of lime	11·20
Silica	1·47
Peroxide of iron and alumina	0·70
Chloride of magnesium	6·30
Sulphate of soda, with traces of potash	4·20
Phosphoric acid	none
Crenate of ammonia	2·85
Combined water at 100° C., organic matters insoluble in alcohol, traces of nitric acid, and loss	4·15
Total grains	35·00

One quart only of this water was evaporated upon a water-bath, and the residue, treated with absolute alcohol, gave a bright yellow solution of crenate of ammonia. Upon the evaporation of the alcohol the compound was obtained as a yellow amorphous mass, yielding a solution in water from which crenate of copper was precipitated. The compound which dissolves in the alcohol appears to contain an excess of crenic acid; for, whilst giving all the characters of this substance and of ammonia, it reacts acid to litmus. Doubtless the neutral crenate loses ammonia during the evaporation of the water, and this volatilised ammonia will be included in the 4·15 grs., part of which represents loss. No other organic substance could be detected in the alcoholic solution.

London, May 31, 1878.

NOTICES OF BOOKS.

Industrial Chemistry. A Manual for Use in Technical Colleges and Schools, and for Manufacturers, &c. Based upon a translation (partly by Dr. T. D. BARRY) of Stohmann and Engler's German Edition of Payen's "Précis de Chimie Industrielle." Edited throughout and supplemented with chapters on the Chemistry of the Metals, &c., by B. H. PAUL, Ph.D. London: Longmans and Co. 1878.

THIS book, in spite of the imposing array of names on its title-page, some of which are well and honourably known in industrial literature, is an additional example of the hopelessness of trying to compress an overwhelming amount of information into a comparatively small compass. The work before us is a very unequal production, much of it being from the hand of a master thoroughly acquainted with his subject, the rest from one who has evidently undertaken a task which was far beyond his powers. Messrs. Paul and Barry's production is at once too large and too small, too copious and too meagre, so that a book which ought otherwise to have proved of the greatest service to the technological student and worker has had its usefulness considerably reduced by defects that might have been avoided with a moderate amount of foresight and consideration. Both the German and English translators and editors have erred in adhering too rigidly to the plan laid down by the original author. The late M. Payen tried to teach too much, and Messrs. Paul and Barry have unfortunately not only followed his example, but gone beyond it. In certain parts of the work, too, there is an apparent want of acquaintance with the progress made by industrial chemistry in this country during the last ten years, which notably lessens the worth of an otherwise valuable and well-written manual. These are grave accusations to bring against a work which has been published under such excellent auspices, but be it said with regret that these charges can be only too easily substantiated.

The origin of the book has already been stated. It is called "Industrial Chemistry," and we are told that it is intended to be used by chemical students in technical colleges and schools, and manufacturers, &c. Judging from the fifth edition of the late M. Payen's "Précis de Chimie Industrielle," upon which Messrs. Stohmann and Engler's translation is founded, he seems to have had the notion of teaching his readers the general principles of theoretical chemistry and their application to the industrial arts simultaneously. A little reflection will show that in the present day such an idea is impracticable, for a student or manufacturer taking up the subject of chemistry applied to the arts would most certainly have already mastered so much of the science as to be beyond the need of elementary instruction in such subjects as the difference between chemical and physical action, specific gravity, combining proportions, chemical nomenclature and notation, quantivalence, and the doctrine of types. If he has not acquired this knowledge he is wholly unfit to study the practical part of the science. In adopting this method Messrs. Paul and Barry have gone far beyond their predecessors, and at the very commencement of their work they give fourteen valuable pages on the mere rudiments of chemistry. At the beginning of every article, too, a large amount of space is taken up with details respecting the discovery, history, and properties of the element or compound under consideration. Methods of production and the properties of substances are described that have no possible connection with chemical manufactures. Such particulars as these are no doubt valuable and interesting, but they are out of place in the present instance. What would be said of the author of a treatise on book-keeping, let us say, who began by instructing his students in spelling or the multiplication-table, or a writer on conic sections who loaded his book with instructions for the solution of simple equations or the extraction of the square root? Not only is the book overburdened with explanations of the most elementary chemical principles, but it is also crowded with descriptions of elements and compounds which at present, at any rate, have not the remotest chance of being made available for industrial purposes. It may be objected that the unique laboratory curiosity of to-day flows into our markets in tons to-morrow; but the copious details given about such rare elements as Se, Te, Ti, Mo, Nb, Di, and a dozen others, might surely have been left out until they had manifested their intention of trying to be of some service to mankind, as well as of allowing themselves to be found in somewhat greater profusion than at present. The natural consequence of this redundancy is, that there is no room left for a host of important details relating to the real subject of the book—Industrial Chemistry. Of such omissions it is easy to collect enough to fill several columns of the CHEMICAL NEWS, a few of them being of such a nature that we hunted through the book from title-page to imprint to see if there was not some promise of a second part or volume. If the most superficial of the frequenters of the Royal Institution were asked to mention the most prominent discovery that was made in industrial chemistry during the last twenty years, he would unhesitatingly mention the coal-tar dyes, and yet only the barest possible allusions have been made to them throughout the whole book. We have long-winded descriptions of Ro, Ru, Ir, Os, and Gl, but such important substances as benzol, anthracen, naphthalin, aniline, in fact nearly the whole of the derivatives of coal-tar, are merely glanced at.

We can hardly turn to a single section of the book without finding some specimens of this unnecessary copiousness, and still more disappointing meagreness. The very first operation that is described under the head of Oxygen is the method of making that gas by heating mercuric oxide—a mode of preparation which is never resorted to except as a lecture illustration. The principal methods of preparing the gas on the industrial scale are then hastily described, and the rest of the space is taken up with the history of the compounds of oxygen, which is quite out of place. To this succeeds an equally superfluous account of the principles of combustion, which the student ought already to have at his fingers' ends. A solution of hydroxyl is now extensively used as a bleaching agent for both live and dead human hair; but a perfumer turning to the method of preparing this compound would find full directions for making it by adding dilute acid to potassium or barium peroxide, but not the slightest clue is given to him as to how he is to obtain the last-named compounds.

Coming to the important subject of Water, we are given analyses of the water of the Möll, near Heiligenblut; of the Oetz, near Vent; of the Gergogne and of the Thé-

rouenne, wherever they may be; but there is nothing about the Trent, the Tyne, the Severn, or the Avon.

The important subject of Filtration is dismissed in half a page, the most modern filtering appliance—for instance, Bischof's spongy iron filters—not even being mentioned.

Passing on to Nitric Acid, we seem to have taken up another book, the article on that important compound being full and clear, and well illustrated with M. Payen's excellent cuts.

Under Ammonia, although the method of liquefying that gas is briefly described, the use of the liquid gas in Carré's ice-making machine is passed over in silence,—a remark which applies with equal force to liquid sulphuric dioxide, which has been so successfully used as a refrigerating agent by M. Pictet, Prof. Gamgee, and others.

Under Sulphur we have excellent descriptions of the method of manufacturing sulphuric acid from pyrites, full of interesting and valuable details. They are well illustrated by numerous cuts, but we miss the beautiful copperplates in the French and German editions, which have been replaced by small wood engravings which are not always too well executed. The account of the Sicilian method of sulphur-refining is well written. Throughout the whole of this article we seem to be under totally different guidance.

The account given of the manufacture and applications of carbon disulphide is equally full and interesting, but why waste so much valuable space in wearying the reader with twice-told tales about famous diamonds and diamond-cutting, leaving the student to search in vain for th method of making battery and electric light carbons?

The manufacture of matches is fairly well treated of under Phosphorus, and under Chlorine Weldon's process is well described.

Under Iodine, English methods of obtaining this important element are—with the exception of Pattinson's—taken no notice of, while several foreign processes are given: in fact we may make the remark, once for all, that throughout the book the translators seem to have pretty constantly ignored the claims of British inventors and manufacturers on their attention.

The section on Fuel is one of the best in the book.

The article on Gunpowder and kindred explosives is open to the two faults we have already had occasion to find so frequently. Not a word is said about pebble powder or on Abel's classical researches on gun-cotton and its congeners. A couple of lines are given to dynamite, and Horsley's and Brian's blasting-powders and lithofracteur are omitted, nearly a page being wasted on M. Payen's favourite explosive, pyroxam. The explosive properties of the picrates are not even mentioned, and mercury and silver fulminates are not to be found at all.

Glass, pottery, zinc, lead, copper, iron (an excellent article), and most of the industrial metals are well described, although the information—especially in the case of nickel—is not always brought down to the latest date. Not a word, for instance, is said about the New Caledonian nickeliferous ores and the ingenious method of extracting the metal from them invented by M. Garnier.

The organic portion of the book is particularly incomplete. The article on Paper opens with a ludicrous blunder; the German phrase *Surrogate für die Lumpen* (substitute for rags) is translated by the English word Surrogate, so that rag substitutes figure throughout as Deputies of the Divorce Court! A detailed account of the various German, Belgian, and French methods of making paper from such rag substitues as straw and wood is given, but our own country is only once mentioned, and that in connection with Bryan Donkin's spherical boiler; and one of our most important raw materials, esparto grass, is not even alluded to. The same ignoring of English processes is to be met with in the part treating of oils and fats, a dozen lines being given to Gossage's silicated soap, and three to Wilson and Gwynne's processes for saponifying fats for candle-making. We should have been glad, too, to have heard a little more about ozokerite paraffin.

The article on Gas and its manufacture, and gas-testing, is in company with that on Iron, one of the best in the book. The same praise may be extended to those on Sugar and India-rubber. Kamptulicon, and other manufactures of a similar nature, being purely English, are entirely passed over.

Under Wines, the method of detecting the presence of false colouring-matter—such as elder-berry juice, logwood, and some half-dozen others—is given; but rosaniline, which is now one of the most common, is left out, although mentioned as particularly dangerous.

Although containing a large amount of useful information, well condensed, the work is greatly lessened in importance by having been, so to speak, built on an utterly wrong system. First of all, it seems to have been a pity that the English edition should have been retranslated from the German when the original already existed in French. Had this not been done much of the clumsiness of style which is frequently apparent would have been avoided, and we should not so frequently be puzzled by obscure passages. A goodly number of misprints crop up here and there, such as Malagutti, Böttcher, pyroxilin, similior, and nitrihydride for nitric anhydride. Some of them, too, are particularly puzzling. In one place, for example, we are told that distilled sea-water is aërated by being *heated* in a drum through which a stream of air is constantly passing: on referring to the original we find that the water is to be beaten (*gepeitscht*) and not heated. The Index, too, is too small for a work of these dimensions, such important words, for instance, as Oxalic Acid, Oxalates, Picric, and Carbolic Acid, and numberless others, being omitted. In the German and French editions the text is illustrated by a series of nearly sixty very beautifully engraved copperplates, but for some unknown reason they are replaced in the English issue by woodcuts, which, though fairly executed, cannot for a moment be compared to the original, either for clearness or size. Some of the originals—the larger plates illustrating the sulphuric acid manufacture, for instance—are sufficiently detailed to form the basis of working drawings.

Comparing the bulk of Messrs. Paul and Barry's book with that of the original, we find that they have added at least half as much again to the text, and have nearly doubled the number of cuts. In form and typography the work closely resembles "Watts's Chemical Dictionary," and is well and clearly printed—a desideratum in a book of this class. Another peculiarity of the book is the almost entire absence of any references to authorities. Surely if the want of space compelled the authors to cut down their account of so important an explosive as dynamite, they might at least have referred us to a more detailed description of it in some other work.

Common Sense for Gas Users; a Catechism of Gas Lighting. By R. WILSON, C.E. London: Crosby Lockwood and Co.

THE title of this little work might, at the first glance, be supposed to convey the insinuation that those persons only who are deficient in the somewhat rare quality styled common sense are likely to make use of gas. Such, however, is not the author's meaning. He strongly advocates coal-gas as an illuminating material, but urges that it is, generally speaking, consumed in an unscientific manner, so that the consumer gets the smallest quantity of light with the greatest expense and nuisance. Mr. Wilson first gives a popular description of the nature of coal-gas, of flame, combustion, air-supply, and smoke. He then passes to a consideration of the qualities of gas, its illuminating power, the standards legally fixed, and the comparative cost of gas in different towns when sale, price, and quality are both taken into consideration.

From the figures given, it appears that the highly illuminating gas of Glasgow, Manchester, and to a less degree of Liverpool, though charged a higher price per thousand cubic feet than the poorer gas of Birmingham, Sheffield, Leeds, or Bristol, is in effect the cheaper. But the difficulty is in getting the public to recognise such facts. The gas company in one of the latter towns had some few years ago an amateur manager, of whom it was facetiously said, that if unable to make good gas, he could do a far harder thing—induce his fellow-townsmen to burn bad gas contentedly, to pay for it cheerfully, and believe in its excellence. The author, however, maintains that with ordinary burners, instead of getting 15 candle light from common gas, five or six candles is the rule. In Glasgow, where the gas is exceptionally good, five or six candles is the rule, instead of the 27 candles at which the gas is supplied, and instead of the 20 candles that can be easily obtained. The higher the quality of gas the greater will be the care required to burn it, so as to get all the light out of it without producing smoke." By the way, it would be interesting to compare the quality of the gas supplied by companies with that furnished by municipal authorities. We strongly suspect that the illuminating power of the latter would be found to average higher.

In his third chapter Mr. Wilson sets forth the advantages of using gas, going in this direction further than we are disposed to follow. He fully recognises the existence of sulphur in coal-gas, and the consequent production of sulphurous acid and ultimately of sulphuric acid in the atmosphere of our rooms. But he contends that it is questionable if the small amount of acid thus generated is capable of doing injury to persons. This may possibly be the case. But if, as our author admits, such acid fumes are capable of damaging books, furniture, and articles of metal, we cannot deny that this is a most serious drawback. It may be true that "light for light" gas is less unhealthy than candles or oil, if we measure unhealthiness simply by the quantity of carbonic acid gas generated. But the author admits that gas is generally used extravagantly, that 50 per cent of its nominal power "should be deducted to allow for the loss by burners and globes, and the height from table," and that gas, as ordinarily burnt, is more injurious than any of the other systems of lighting. That an improved system of ventilating houses, joined to a careful selection of perfect gas-fittings, would very greatly diminish the evil effects of gas is perfectly true. But to nine-tenths of the British public this is but poor consolation. Few, indeed, live, or can live, in houses so arranged that the products of combustion can pass away at or near the ceiling. The author's plea that "instead of being an objection to its use, the smell should rather be considered as one of the greatest advantages in using gas" is highly *naïve*. It may, indeed, be an advantage in coal-gas as against a supposed inodorous gas which might escape unperceived. But how it can be an advantageous feature in gas, as compared with lamps or candles, we fail to perceive. To the student who wishes to economise his eyesight, the flickering of gas, which, in practice, never burns with the steadiness of a well-trimmed lamp, is no small annoyance. There is another evil resulting from gas-lighting, to which the author makes no reference: the pollution of the subsoil in our streets. London has scarcely been lighted with gas more than half a century, yet whenever a road is taken up, how frightful is the odour of the earth which has been in contact with the gas-pipes and has absorbed the leakage. And herewith is connected a further peril: a house where the gas-fittings are faultless, or even one not lighted with gas at all, may become the scene of an explosion, owing to the escape from an adjacent main. All these defects, and others which we have here not space to mention, make us hope that gas may soon "pale its ineffectual fires" before the light of the future,—the electric light. Giving off neither carbonic acid, sulphurous acid, nor watery vapour, incapable of exploding or of occasioning conflagration or nuisance, and possessing a purity and brilliance in comparison of which the best gas-flame appears of a dirty yellow, it cannot fail, before long, to be introduced at least in our squares, churches, railway stations, public halls, and other large spaces requiring illumination.

But though we cannot join the author in his recommendation of gas, we are bound to admit that to gas consumers a careful perusal of his work may save a very heavy amount of expense and annoyance. He points out the errors of the gas-fitters in a style that marks the man of extensive experience and close observation.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

APRIL, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Clear	0·000	0·009	0·105	0·089	18·00	7·840	0·360	0·79	1·430	12·1	3·30
West Middlesex	Clear	0·000	0·009	0·129	0·053	17·10	7·840	0·396	0·87	1·430	12·6	2·80
Southwark and Vauxhall	Clear	0·000	0·008	0·105	0·046	18·10	7·890	0·432	0·87	1·480	12·6	2·80
Chelsea	Clear	0·000	0·008	0·150	0·046	18·20	7·750	0·396	0·87	1·330	12·6	2·50
Lambeth	Clear	0·000	0·008	0·164	0·042	19·40	8·170	0·432	0·94	1·500	13·2	3·30
Other Companies.												
Kent	Clear	0·000	0·003	0·435	0·014	28·70	11·480	0·540	1·44	3·560	19·4	6·00
New River	Clear	0·000	0·006	0·165	0·042	17·40	7·840	0·360	0·87	0·930	12·6	2·40
East London	Clear	0·000	0·008	0·165	0·042	18·70	7·630	0·430	1·08	1·600	12·6	3·30

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B.

CORRESPONDENCE.

DETECTION AND ESTIMATION OF FREE MINERAL ACID IN SULPHATE OF ALUMINA.

To the Editor of the Chemical News.

Sir,—As a brief extract of the paper read before the Chemical Society which appeared in the Chemical News, vol. xxxvi., p. 211, is not accurate in some of its details, may I beg to offer the following correction. In qualitatively testing for free acid I use a *very weak* solution of the peracetate, but for quantitative results a *strong* one. For the quantitative method, which your reporter alone gives, a much stronger solution than the one described will be found necessary.—I am, &c.,

A. Esilman.

Manchester, May 29, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 17, April 29, 1878.

Production of the Laminary Systems of Plateau.—A. Terquem.—The author, by substituting in the polyhedra of Plateau flexible wires for a certain number of rigid rods, produces very readily and with a minimum quantity of liquid laminary systems of very considerable dimensions.

Ultra-violet Absorption Spectra of the Earths in Gadolinite.—J. L. Soret.—The author has been repeating the observations of MM. Marignac and Delafontaine, which show the presence of yttria and erbia, and probably of terbia (erbia of Mosander). A fourth earth which the author merely designates as *x* seems likewise to be present. The author appends to his paper a diagram of the spectra of the four bodies.

Formation of Metallic Arsenides.—A. Descamps.—An account of the arsenides of lead, nickel, cadmium, zinc, iron, bismuth, tin, and antimony.

Electric Discharge in Tubes Containing Rarefied Gases.—MM. Warren de la Rue and Hugo W. Müller.—The discharge in a tube of rarefied gas does not differ from that which takes place in air or other gases at the atmospheric pressure. It is not a current in the ordinary sense of the term, but a disruptive discharge, the gaseous molecules effecting a transport of electrisation. The gases probably receive two impulsions in opposite directions, that from the negative electrode being the more continuous. There are sometimes formed metallic spots upon the tubes, which leave a permanent trace of the intervals comprised between the strata.

Magnetic Rotation of the Plane of Polarisation of Light under the Influence of the Earth.—H. Becquerel.—The author describes an experiment for demonstrating the above phenomena.

Suppression of the Return Wire in the Use of the Telephone.—M. Bourrouze.—The authors have found that the circuit may be closed by the earth without a return wire, the sounds being transmitted with great distinctness.

Transparence of Coloured Flames for their Own Radiations.—M. Gouy.—An account of the result of spectroscopic researches on narrow rays. The author adds in conclusion that in conjunction with M. Thollon he has studied the spectrum of barium, and has succeeded in resolving its bands into a great number of fine rays, perfectly well defined.

Vapour Density of Ammonium Sulphide.—G. Salet.—On mixing equal volumes of hydric sulphide and of ammonia at the temperature of 80° no contraction was observed.

Solution of Platinum in Sulphuric Acid.—M. Scheurer-Kestner.—In a former communication (*Comptes Rendus*, lxxxi., p. 892) the author has shown that during the industrial concentration of sulphuric acid in vessels of platinum, the quantity of this metal dissolved in acid free from nitrous compounds increases with the concentration of the acid. New experiments undertaken for the purpose of preparing fuming sulphuric acid have induced him to continue his observations. The action upon the metal, so much promoted by concentration beyond 95 per cent, is still further intensified with the concentration of the monohydrated acid. On decomposing sodium bisulphate by heat in earthen retorts lined with platinum, 1 grm. of metal was dissolved for each kilo. of fuming acid produced. The metal is found in a soluble state mixed with the sodium sulphate.

On Vitreous Melted Saccharose.—H. Morin.—If heated with water under certain conditions saccharose is transformed into a vitreous product, which preserves its transparency more or less according to the manner of cooling. If this has taken place gradually the product is translucid, but mixed with prismatic crystals. If the cooling is rapid this partial crystallisation is avoided. It contains on an average 3·28 per cent of water, and its sp. gr. at 14·5° is 1·966.

Certain Derivatives of Isobutylic Ether.—E. Demarçay.—In a former communication the author has shown that it is possible by means of ethylacetic ether to obtain a series of compounds corresponding to the formulæ:—$3C_nH_{2n-4}O_2+H_2O$ and $3C_nH_{2n-4}O_3+H_2O$ The process for obtaining these acids consists in decomposing with alcoholic potassa the bromised derivatives of the substituted acetylacetic ethers. The author has now examined this reaction upon isobutylacetic ether, and ascertained the circumstances and the secondary reactions which determine or accompany the formation of this body.

No. 18, May 6, 1878.

Extension of Fourier's Formulæ Relating to the Propagation of Electricity.—A. Cornu.—There is a complete similarity of movement between the transmission of electricity and that of elastic waves, and the expression "electric wave" is under certain conditions perfectly justifiable.

Telegraphic Use of the Telephone.—M. Gressier.—An inquiry into the nature of various sounds heard when the telephone is connected with or runs in the proximity of a telegraphic line. After the paper had been read M. du Moncel pointed out that the currents mentioned by M. Gressier had been long ago studied with simple galvanometers, and had been the subject of four memoirs presented by him to the Academy of Sciences in 1872 (*Comptes Rendus*, lxxv., p. 956, 1098, 1504, and 1622).

Crystallisation of Silica in the Dry Way.—P. Hautefeuille.—Acid phosphate of soda and tungstate of soda are both agents in the mineralisation of silica, but the latter exerts a more energetic action, even at a lower temperature, which permits its employment for the reproduction of the numerous silicates, more or less fusible, associated with silica in rocks.

Isobutylacetylacetic Ether.—Eug. Demarçay.—In a previous communication the author has described the different reactions which monobromated isobutylacetylacetic acid undergoes under the influence of alcoholic potassa. He now makes known the processes by means of which the different products are prepared and separated.

A New Method of Preparing Propyl-glycol.—M. Hanriot.—The author employs aceto-brom-hydrine, which is easily prepared by the action of acetyl bromide upon glycerin. The product of the reaction is distilled in a vacuum, and passes over almost entirely about 175° under a pressure of 10 centimetres of mercury. The hydrogenisation is conducted in a neutral liquid by means of Dr. Gladstone's coppered zinc, and is completed in about twenty-four hours. The product when hot is mixed with carbonate of potassa in excess and the paste is exhausted with alcohol. The acetate of propyl-glycol, saponified by an alcoholic solution of potassa, yields isopropyl-glycol.

An Isomer of the Monochlor-hydrin of Glycerin.—M. Hanriot.—Theory points to the existence of two isomers for the first hydrochloric ether of glycerin, one representing chlorated propyl-glycol and the other chlorated isopropyl-glycol. M. Berthelot has obtained the second of these ethers by the action of hydrochloric acid upon glycerin. The author finds that the same reaction yields also a small quantity of the former.

Decomposition of Ethylic Alcohol by Zinc Chloride at High Temperatures.—W. H. Greene.—The products of the reaction were in addition undecomposed alcohol, a small quantity of ether and oily products, which are probably polymers of ethylen, aldehyd, and water.

Novel Method of the Formation of Oxide of Ethyl.—W. H. Greene.—On heating sodic oxide to 180° with ethyl iodide the author observed the formation of a notable quantity of oxide of ethyl.

Berichte der Deutschen Chemischen Gesellschaft, No. 4, March 11, 1878.

Preliminary Communication Concerning a New Chloride of Camphor.—F. V. Spitzer.—When the action of pentachloride of phosphorus upon camphor is conducted so as to avoid every elevation of temperature there is formed an almost pure bichloride of camphor. It is distinguished from the compound described by Pfaundler by its melting-point, which is from 150° to 155°, whilst Pfaundler's bichloride melts at 70°.

Chlor-cymol Obtained from Thymol, and Closely Connected Compounds.—E. v. Gerichten.—Not adapted for useful abstraction.

Boiling-points of Sulphuric Acid at Various Degrees of Concentration.—G. Lunge.—From the table drawn up by the author it appears that sulphuric acid of sp. gr. 1·8400 (at 15°) boils at 297°, and that of sp. gr. 1·0580 at 101·5°.

Oxytoluylic and Oxyphthalic Acids.—O. Jacobsen.—The author has obtained four oxytoluylic and four oxyphthalic acids from the four xylenols which he has recently discovered.

Formation of Dichlor-propionic Acid from Pyruvic Acid.—H. Beckurts and R. Otto.—The formation of α-dichlor-propionic acid from pyruvic acid by the action of phosphorus pentachloride does not depend upon any process which goes off evenly, and it would therefore be hazardous to regard pyruvic acid as a keton acid of the formula $CH_3 \cdots CO - \cdots COOH$.

Constituents of Corallin.—K. Zulkowsky.—These are a garnet-red body with a blue surface reflection, but without metallic lustre, forming large crystals, $C_{19}H_{14}O_3$. A derivative of this substance, $C_{19}H_{16}O_6$, which crystallises readily in small violet needles, and is easily decomposed by heat. A compound, $C_{20}H_{16}O_3$, crystallising in green needles, with a metallic lustre. The hydro-product of the above, $C_{20}H_{18}O_3$. An amorphous resinous substance, colourless when pure. An oxidation-product of the above; a deep red amorphous powder with a slight metallic lustre: in its properties it agrees with the compound which Baeyer obtained from phthalidein and phenol. The aurin of Dale and Schorlemmer was not to be found in the author's corallin.

An Isomeric Nitrophthalic Acid.—O. Miller.—The author announces a full description of this compound as to appear in the *Proceedings* of the Russian Chemical Society.

Zinc Ores from the Neue Helene Grube, at Scharley, near Beuthen, in Upper Silesia.—A. Lindner.—A geological and chemical account of the ores, and of the limestones in which they are contained.

On Azophenols.—P. Weselsky and R. Benedikt.—Ortho-azophenol, $C_{12}H_{10}N_2O_2$, forms splendid leaflets of a golden lustre, soluble in alcohol and ether, but perfectly insoluble in water. It dissolves in potash-lye with a fine reddish yellow colour, and is re-precipitated unchanged by acids. It melts at 171°, and sublimes undecomposed.

Action of Chloro-carbonic Oxide upon Xylol in Presence of Chloride of Aluminium.—E. Ador and A. Rillet.—The result of the reaction is a keton, which boils at 340° and does not congeal, even if kept for twenty-four hours at −60°.

Examination of the Action of a Copper-zinc Element upon Alkaline Oxy-salts.—J. H. Gladstone and A. Tribe.—Translated from an English source.

MISCELLANEOUS.

Soirée of the Chemical Society.—On Thursday, May 30th, Dr. Gladstone, F.R.S., P.C.S., gave a *soirée* to the Fellows of the Chemical Society, at Burlington House. Amongst the numerous objects of interest were the following:—A magnificent collection of immediate principles from the brain, exhibited by Dr. Thudichum, who also demonstrated the absorption-spectrum of a new colouring matter, ovocruentin, derived from egg-shells, the bands being identical with those of cruentin obtained from the blood. In the library were specimens of artificial corundum and emerald, made by Feil and Frémy; a large Cape diamond, exhibited by Prof. Tennant; a collection of precious stones from Hunt and Roskell, including a fine pink topaz, cat's-eyes, and a large crystal of garnet; some interesting apparatus of Faraday, amongst which was his rheostat; a collection of alkaloids from opium, aconite, and veratrum, by Dr. Wright; a splendid case, by W. H. Perkin, illustrating the colouring-matters from aniline, anthracen, &c.; a specimen of artificial alizarin, and preparations of natural and artificial salicylic acids, the latter of which the exhibitors, Messrs. Hopkin and Williams, have succeeded in obtaining in crystals exactly resembling those of the natural product; minerals containing liquid carbonic acid were shown by W. N. Hartley, who also demonstrated the effect of heat on the liquid enclosed in the cavities; crystals from Owen's College, including a large, almost perfect, octahedron of chrome alum; various interesting products, &c., were exhibited by Prof. Odling, Prof. Frankland, Dr. Russell, Dr. Armstrong, Dr. Witt, Dr. Schorlemmer, Dr. Hugo Müller, and M. M. P. Muir. In the room adjoining the lecture room were some candles which had been acted upon by sea water for 173 years, a large collection of meteoric stones, an interesting series of photographs of invisible fluorescent bodies, &c., exhibited by the President; a splendid photograph of the solar spectrum, shown by Prof. Rutherford; the spectrum of bismuth was shown by Messrs. Browning; dichroic crystals of nickel and cobalt salts, by J. M. Thomson; photographs illustrating recent researches in solar chemistry, by J. N. Lockyer; an enormous cut cairngorm, weighing 51 ozs., an opal cameo, and various minerals, by Bryce Wright, &c. In the lecture and preparation rooms were the microphone, exhibited by Prof. Hughes, which attracted considerable interest. Mr. W. De La Rue showed some phosphorescing tubes, which, after a momentary exposure to some burning magnesium, flashed back all the colours of the spectrum; Byrne's pneumatic battery and the copper-zinc couple were shown in action.

Messrs. Murray and Heath exhibited under the microscope some pretty crystals of gold, silver, &c. Sir Joseph Whitworth and Dr. Siemens showed specimens of steel; in the same room Dr. Guthrie exhibited the formation of cryohydrates. Many other objects of interest were exhibited, but it would be impossible to enumerate all. On the whole, the *soirée* was most successful, and although the attendance was numerous the arrangements were so good that at no time were the rooms inconveniently crowded.

MEETINGS FOR THE WEEK.

SATURDAY, 8th.—Physical, 3. "The Microphone," Prof. Hughes. "The Electrical Properties of Bees'-wax and Lead Chloride," Prof. Ayrton. "The Reflection of Polarised Light," Sir J. Conroy.
TUESDAY, 11th.—Royal Institution, 3. "Minute and Low Forms of Life," Rev. W. H. Dallinger.
— Photographic, 8.
— Anthropological Institute, 8.
THURSDAY, 13th.—Royal Institution, 3. "On Molecular Physics: Solids," Prof. Guthrie.
— Mathematical, 8.
FRIDAY, 14th.—Royal Institution, 8, Weekly Meeting. "Liquefaction of Gases," Prof. Dewar, 9
— Astronomical, 8.
— Quekett Club, 8.
SATURDAY, 15th.—Royal Institution, 3. "On Joseph Addison," Prof. Henry Morley.

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JOSEPH HERON, Town Clerk.
Town Hall, Manchester, 31st May, 1878.

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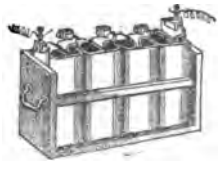

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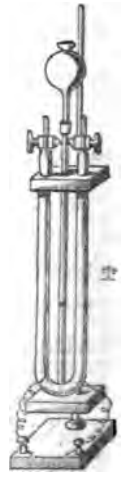

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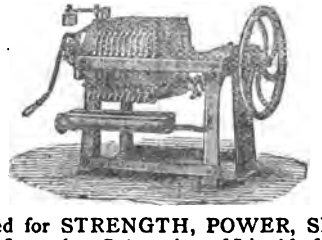

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THE CHEMICAL NEWS.

Vol. XXXVII. No. 968.

ON AREOMETERS.*—Part I.

By P. CASAMAJOR.

The last paper which I had the honour of reading before this Society related to the corrections of the errors due to changes of temperature in volumetric analysis; and although the results which I gave found their application in an important branch of chemical science, I am not sure that my paper had otherwise a very close connection with chemistry. The favourable reception of this paper by many members, who have expressed to me a great interest in its subject, induces me to offer you, this evening, a paper of a similar character on areometers. Such is the constant use made by chemists of these useful and convenient instruments that I feel I owe no apology for presenting the subject. In the first place, I propose to examine the nature of the scales of the areometers most generally used, and, in the second place, to apply the data obtained by this examination, and those given in the last paper which I read before this Society, to the correction of the errors resulting from variations of temperature.

Part First.—Scales of Areometers.

A great portion of what I have to say on the scales of areometers I have published already on several occasions;† and although it is with regret that I have to present you with matter that I have published elsewhere, I have found no way of avoiding it, as otherwise the new matter I have to present would be incomprehensible.

Areometers are formed of two portions—the stem, which bears the graduation, and the bulb, whose diameter is considerably larger, and whose object is to avoid excessive length of the instrument. I must, however, for the purpose of studying the graduation of areometers, discard the bulb, and suppose that we have a geometrical cylinder of indefinite length.

If this areometer (A B) is to be used for liquids heavier than water, we will suppose that its weight is such that, when immersed in pure distilled water, at the normal temperature, it will sink to a point, *c*, near the top of the cylinder. This is an important reference point in all areometers, as it corresponds to the unity of specific gravities of liquids.

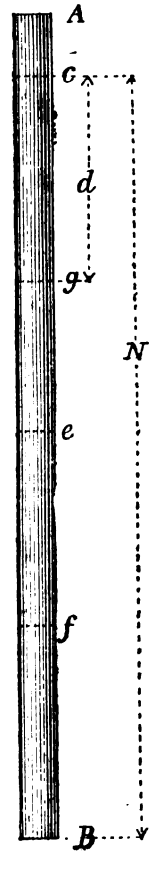
As a floating body is in the state of equilibrium in a liquid when the weight of the liquid displaced is equal to the weight of the floating body, if we place our cylindrical areometer, which sinks to *c* in pure water, in a liquid whose specific gravity is double that of water, it will sink to a point *e*, placed in such a manner that—

$$Be = \frac{Bc}{2}.$$

This happens because, in a geometrical cylinder, the distances Bc, B*e* are proportional to the volumes between these points, and because the new liquid, being twice as heavy as water, takes half the volume to float the areometer. In the same manner, if it was possible to obtain a liquid four times heavier than water, the areometer would sink to a point *f*, so placed that—

$$Bf = \frac{Bc}{4}.$$

If now we call the specific gravity of water 100, and if we place numbers opposite to *c*, *e*, *f*, which express the corresponding specific gravities, we shall have 100 opposite to *c*, 200 opposite to *e*, and 400 opposite to *f*. If we make intermediate divisions, each expressing an increase of specific gravity equal to 1-100th part of the specific gravity of water, there will be 100 such divisions between *c* and *e*, and 200 between *e* and *f*. The space *ef* is, however, one-half of *ce*, so that rhe mean length of a division between *c* and *e* must be four times greater than that of a division between *e* and *f*. By making the same calculation for any portion of the stem, we may see that the decrease of the length of the divisions is gradual from *c* to *f*. A scale of this kind is called *uneven*.



We may, on the other hand, starting from the point *c*, divide the space *c* B into a certain number of equal parts. A scale of this kind is called *even*, and I may remind you that the greatest portion of the areometers used in the arts have even scales.

We are naturally led to inquire whether any relation exists between even scales and scales expressing specific gravities. I have seen it clearly stated in books that no such relation exists, and that the correspondences of these divisions are found by means of tables, which, it must be inferred, were obtained experimentally, or by means of empirical formulas.

I believe that Francœur was the first mathematician who studied the relations between these two classes of scales, and he has left us two formulas; one for Beaumé's areometer for liquids heavier than water—

$$P = \frac{152}{152 - d},$$

* Read before the American Chemical Society, April 5, 1877.

† "Testing Sugar Solutions" (*American Chemist*, Oct. and Nov., 1873). "On the Formula of Francœur, &c." (*Ibid.*, Feb., 1874). "Expansion of Sugar Solutions by Heat" (*Ibid.*, June, 1874). "Nouveau Procédé pour la Détermination du coëfficient de pureté des dissolutions sucrées" (*Moniteur Scientifique*, March, 1877).

and the other for Beaumé's instrument for liquids lighter than water—

$$P=\frac{146}{136+d}.$$

In these formulas P represents the specific gravity, while d is the corresponding degree of an even scale.

We shall have occasion to return to these formulas, after we have studied the general relation which exists between the divisions of even scales and their corresponding specific gravities.

To discover this relation, let us suppose that we have placed our cylindrical areometer in a liquid of specific gravity, P, and that it has sunk to a point, g, of the stem. As the weight of liquid which buoys up an areometer must be equal to the weight of the areometer itself, the volumes of liquid displaced are inversely as their specific gravities. Now if we divide the space cB into a certain number, N, of equal parts, and if we find a number (d) of these divisions between c and g, the distance cB, which is the portion submerged in pure water, will be expressed by N divisions or degrees, while the space gB, the portion submerged in a liquid of specific gravity P, will be $N-d$, and we shall have the equation—

$$\frac{P}{1}=\frac{N}{N-d},$$

from which, knowing d, we may calculate the value—

$$N=\frac{Pd}{P-1} \quad . \quad . \quad (1)$$

From this equation we may find the whole number of degrees of even scale from c downwards. This number N is obtained by multiplying the specific gravity by the corresponding number of degrees, and dividing this product by the difference between the same specific gravity and unity.

If we know the value of N for any scale, we may, inversely, calculate the value of d when P is known, or the value of P when d is known, by these formulas :—

$$P=\frac{N}{N-d} \quad . \quad . \quad (2)$$

$$d=N-\frac{N}{P} \quad . \quad . \quad (3)$$

In Beaumé's original areometer for liquids heavier than water, 15° corresponded to sp. gr. 1·109. Formula (1) will give us, in this case,—

$$N=\frac{1\cdot109\times15}{0\cdot109}=\frac{16635}{109}=152\cdot6.$$

If we neglect 0·6, formula (2) will give us—

$$P=\frac{152}{152-d},$$

as given by Francœur.

Although this formula was correct for the original *pese sel* of Beaumé, it does not answer for the instrument now sold as Beaumé's areometer, in which 66° correspond to the point to which the instrument sinks in sulphuric acid, H_2SO_4. Taking 1·845 for the specific gravity of H_2SO_4, we have by formula (1)—

$$N=\frac{1\cdot845\times66}{0\cdot845}=\frac{121770}{845}=144\cdot02, \text{ or } 144.$$

As Beaumé's areometer is extensively used in the arts, many chemical, technological, and pharmaceutical books give tables for the conversion of its indications into corresponding specific gravities. In these tables N is sometimes 152, sometimes 144, and at other times 145, 145·4, &c. It is a matter of some importance to determine the value of N in any table. Fortunately this may be done at a glance by observing the degree Beaumé which is equal to the fractional part of the number expressing the corresponding specific gravity. The quantity N is that specific gravity multiplied by 100. If we find in a table that 52° B = 1·52 sp. gr., then N = 152; for if in the equation—

$$P=\frac{152}{152-d}$$

we make d equal to 52, P will be 1·52, and if in the equation—

$$P=\frac{144}{144-d}$$

we make $d=44$, P will be 1·44.

It is very easy to do for other areometers what we have done for Beaumé's *pese sel*. Let us take, in the next place, Beaumé's areometer for liquids lighter than water, which is extensively used in this country for petroleum products of all kinds. Beaumé obtained the scale of this instrument by calling 0 the point of the stem to which the areometer sinks in a solution of 10 parts of salt in 90 parts of water, and 10° the point to which it sinks in water. The instrument is graduated from 10° upward.

To find the value of N, let us temporarily call 0 the point to which it sinks in pure water, and 10° the point to which it sinks in a solution containing 10 per cent of salt, whose specific gravity is 1·07353. By formula (1) we have—

$$N=\frac{1\cdot07353\times10}{0\cdot07353}=\frac{1073530}{7353}=145\cdot99, \text{ or } 146.$$

As in this instrument the total number of degrees below 0 is 136, when the degree indicated is d the volume that sinks in the liquid is $136+d$, and we have—

$$\frac{146}{136+d}=\frac{P}{1},$$

whence—

$$P=\frac{146}{136+d},$$

and—

$$d=\frac{146}{P}-136.$$

This formula was also given by Francœur.

Next to Beaumé's *pese esprit*, we are naturally led to speak of Cartier's areometer, much used in the South of France for brandies. In this instrument 10° correspond to sp. gr. 1, as in Beaumé's, but 40° correspond to 44° B.; therefore the space occupied by 11° B. corresponds to 10° Cartier, and the value of N is—

$$\frac{146\times10}{11}=132\cdot72,$$

nearly 133, and the formula giving the relations of the specific gravities to degrees Cartier become—

$$P=\frac{133}{123+d},$$

$$d=\frac{133}{P}-123.$$

In the next place I propose to apply our formulas to an areometer of even scale, of which we heard a great deal at our last meeting. I mean the lactometer of the New York Board of Health. In this instrument 0 represents the point of the stem to which it sinks in pure water, and 100° represents the point to which it sinks in a liquid having the specific gravity 1·029.

Formula (1) becomes in this case—

$$N=\frac{1\cdot029\times100}{0\cdot029}=\frac{102900}{29}=3548\cdot2,$$

in which we may neglect 0·2.

Formulas (2) and (3) become—

$$P=\frac{3548}{3548-d},$$

$$d=3548-\frac{3548}{P}.$$

In the next place I propose to apply these formulas to the areometer of Balling, which shows the quantity of sugar, by weight, in 100 parts of a solution. Although this areometer, as found at the dealers, has always an even scale, the percentages of sugar cannot be expressed by such a scale. We may, however, if we only take a limited portion of a scale, in which every degree represents an additional 1 per cent of sugar, have an even scale in which the errors are not appreciable, by taking for the average length of every degree the length of the degree equally distant from the extremes. The Balling areometer, which I use in my process for testing sugar solutions, ranges from 5° to 15°, and I have adopted an even scale of which 1·805° is equal to 1° Beaumé, this being the relation at 10° Balling. For this instrument, to which we shall have occasion to refer in the second part of this paper, the value of N is $144 \times 1{\cdot}805 = 259{\cdot}92$, or 260. For the whole Balling scale I have found that the formula $D = 1{\cdot}8\,d + 0{\cdot}002\,d^2$, in which D is the degree Balling, and d the degree Beaumé, gives values of D which are correct within less than ½° Balling up to 75° Balling, thus:—

10°	Beaumé give	18·2	instead of	18·05
20	,,	36·8	,,	36·44
30	,,	55·9	,,	55·47
40	,,	75·2	,,	75·27

Having now examined, to specific gravity scale, Beaumé's two areometers, the *pese esprit* of Cartier, the lactometer of the Board of Health, and the areometer which indicates the percentage of sugar in a solution, I believe I have reviewed all the instruments of this kind that are used to any extent, except alcoholometers and Twaddle's hydrometer. Alcoholometry is too extensive a theme to be brought incidentally into our subject. Besides, little or nothing remains to be said about it after the labours of Tralles and Gay-Lussac. As to Twaddle's scale, it is a disguised specific gravity scale, in which the specific gravity of water, instead of being 1, is 200. This number, however, is subtracted from the indication. Thus, specific gravity 1·12 is 240, but is written 40; specific gravity 1·8 is 360, but is written 160; so that to find the specific gravity corresponding to the indication of Twaddle's scale we must add 200, and divide the sum by 200.

There is a quality in areometers called *sensitiveness*, by virtue of which a small difference of density in liquids corresponds to a decided difference in the scale of the instrument. If we suppose that our areometer is a geometrical cylinder, the distance between two indications of the scale corresponding to two specific gravities is proportional to the whole length of the instrument, from the point corresponding to pure water to its lower extremity. From this we may deduct a convenient method of expressing numerically the sensitiveness of an areometer by supposing it to be a geometrical cylinder, and stating its length in inches. This quantity is easily calculated, in the case of an even scale, by finding a certain number of inches corresponding to a certain number of degrees. If we take the coarse Beaumé areometer, having a thick stem, which is commonly used in the arts, in which 12½° are comprised in the length of an inch, we shall find the whole length to be—

$$\frac{144}{12\frac{1}{2}} = 11\tfrac{1}{2} \text{ inches.}$$

In the lactometer of the Board of Health 100° occupy 3⅜, or 3·625 inches; then the whole number of degrees, 3548, would occupy—

$$\frac{3{\cdot}625 \times 3548}{100} = 128{\cdot}61 \text{ inches} = 10 \text{ feet } 8{\cdot}61 \text{ inches.}$$

In the areometer which I use for testing sugar solutions, 6° Balling, divided into tenths, occupy 2½ inches, so the whole number of degrees = 260 must occupy—

$$2{\cdot}5 \times \frac{260}{6} = 111\tfrac{3}{4} \text{ inches} = 9 \text{ feet } 3{\cdot}6 \text{ inches.}$$

To find the total length of a specific gravity areometer we may calculate the number of degrees of an even scale which correspond to two points placed a known distance apart, and thence find the length corresponding to the whole number of degrees. Geisler's areometer for Ventzke's sugar test, studied in this way, gives a whole length of 200 inches, or 16⅔ feet.

We have seen that if we know the specific gravity of a liquid we may deduct the corresponding degree of any even scale, and *vice versa*. These relations afford us a sure method of verifying the correctness of the graduation of any areometer of even scale, by determining with the balance the specific gravity of a liquid, and comparing the corresponding division of even scale with the indication of the areometer under observation.

We may also convert the indications of any areometer of even scale into corresponding degrees of any other even scale. This is done by dividing the number of degrees to be converted by the total number of divisions of its kind, and multiplying this quotient by the total number of divisions of the kind we require. If we wish to know, for instance, what degree Beaumé is equivalent to 100° of the lactometer of the Board of Health, we shall find that—

$$\frac{100 \times 144}{3548} = 4{\cdot}058° \text{ Beaumé.}$$

Areometers of even scale have this precious property, that, provided the divisions are equal to one another, and the calibre of the stem is even, we may obtain accurate results by their use, even if the divisions have not the proper length, and if the point corresponding to pure water has been misplaced. By determining the specific gravity corresponding to two points of an even scale under observation, we may correct any indication of such a scale. In the *American Chemist* for October, 1873 (vol. iv., p. 130), and in *Sugar Cane* for January, 1874 (vol. vi., p. 28), these calculations may be found at full length.*

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* On reading over the corrections for areometers of even scale, in the *American Chemist* for November, 1873, I find that the subject may be presented in a more satisfactory manner, and more in harmony with the results of this paper, as follows:—

To ascertain the correctness of an areometer of even scale, we find by compasses and callipers that the divisions are equal to each other, and that the calibre is even—otherwise the instrument is not fit for accurate work. If these two points are satisfactory, we make two solutions, A and B, of different densities, B being the more dense. A must correspond to one end of the scale, and B to the other, but both must be within the scale. The temperature of the solutions should not be very different from that of the room, so as to remain constant for some time. The areometer to be examined should be placed successively in each solution; let us call the two indications a and b. In the next place, the specific gravity should be taken by the balance, which we will call P for A, and P′ for B. The degrees corresponding to P and P′ are calculated in the case of the total number of degrees N, and we obtain—

$$c = N - \frac{N}{P},$$

$$e = N - \frac{N}{P'}.$$

If $a = c$ and $b = e$, the areometer is properly graduated.

If a is not equal to c, and b is not equal to e, but still $b - a = e - c$, the divisions of the scale are correct, but have been misplaced, the misplacement $m = c - a = e - b$, m being positive or negative, and it has to be either added to or subtracted from the degree of the areometer to effect the correction.

Again, a may be greater or smaller than c, and b greater or smaller than e, and at the same time $b - a$ is not equal to $e - c$. In this case the degrees themselves have not the proper length, and we are led to ask what is N′, the total number of degrees of the areometer under examination? If we call n' the number of degrees between c and e, and n the number between a and b, we have the relation—

$$\frac{N'}{N} = \frac{n'}{n},$$

whence—

$$N' = \frac{n' N}{n}.$$

When the degrees of the scale have not the proper length, two

In conclusion of this first part I will examine a point which was introduced at our last meeting. We were told that if we refer the divisions of an areometer of even scale, and the corresponding specific gravities -1 to rectangular co-ordinates, the law of their relations is expressed by a right line. To those who remember their analytical geometry it is easy to show that this is not the case, for if we take the equation—

$$\frac{Pd}{P-1}=N,$$

which we have had to use repeatedly, and in which are comprised the quantities d and $P-1$, and if we multiply both terms by $P-1$ and divide them by P, we shall have—

$$d=(P-1)\frac{N}{P}.$$

Now the equation of the right line is of the form $d=m(P-1)$, in which m is a constant, while—

$$\frac{N}{P}$$

cannot be a constant as P is variable; therefore—

$$d=(P-1)\frac{N}{P}$$

cannot give a right line.

By actually referring d and $P-1$ to perpendicular co-ordinates, we find that the law is expressed by a curve which does not differ materially from an arc of a circle, which curve turns its concavity towards the abscisses. The greatest deviation from a right line takes place about midway between the two extremes. This may be illustrated by taking Beaumé's areometer from 0° to 50°, in which 0° corresponds to $P-1=0$, and 50° to $P-1=0{\cdot}532$. If the law was a right line we should have the numbers of the second column, while the actual numbers are those in the third column.

Degrees Beaumé.	$m=\frac{P-1}{d}=\frac{0{\cdot}532}{50}$ $m=0{\cdot}01064$	$P-1=d\frac{N}{P}$.	Difference.
10°	0·1064 (14°)	0·0746	0·0318
20°	0·2128 (25°)	0·1613	0·0515
25°	0·2666 (30°)	0·2101	0·0565
30°	0·3192 (35°)	0·2632	0·0560
40°	0·4256 (43°)	0·3846	0·0410

After the values of $P-1$, in the second column, I have placed between parentheses the nearest whole number of degrees to which they correspond.

(To be continued).

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cases may occur:—(1.) The 0° (pure water, normal temperature) is in the right place. (2.) The 0° has been misplaced. If—

$$\frac{a}{c}=\frac{b}{e}=\frac{N'}{N},$$

the zero is in its place; and if we call d' any degree of the areometer under examination, the correct degree,—

$$d=\frac{d'\times N}{N'}.$$

If the 0 of the scale has been misplaced, the relation—

$$\frac{a}{c}=\frac{b}{e}=\frac{N'}{N}$$

does not exist. To discover the amount of displacement we must take either of the specific gravities, P or P', and determine the true degree corresponding to either a or b, on the base of N' being the total number of degrees. If we take a and sp. gr. P, the true degree,—

$$x=N'-\frac{N'}{P}.$$

The quantity $x-a$ shows the displacement m, which is positive if $x>a$, or negative if $a>x$, and the true degree—

$$d=\frac{N}{N'}(d'\pm m).$$

SOME REACTIONS WITH LINDO'S TEST FOR SOME OF THE BASES IN OPIUM.

By Prof. HOW.

The following reactions, got precisely in the way detailed by Mr. Lindo (Chem. News, vol. xxxvii,, p. 158), may be of sufficient interest to place upon record.

Papaverin dissolves in H_2SO_4 to a pale purple fluid, which becomes very pale and then brownish on standing about an hour. The addition of Fe_2Cl_6 and warming cause the purple colour to change quickly to yellow, while the liquid becomes turbid; the addition of water gives a colourless liquid, becoming pale yellow next day.

Narcotine dissolves to a bright yellow liquid, becoming orange on standing about an hour; then, treated as above, a-blood red is produced, soon assuming a purplish tinge, then a bright red, resembling the ferric sulphocyanide, and remaining permanent at least for a fortnight.

Cotarnine gives first a clear, dark brownish yellow solution; then, with Fe_2Cl_6, a whitish precipitate, dissolving to a dark red fluid, which, with water, assumes much of the colour obtained with narcotine, but perhaps paler: it is equally permanent.

Narceine dissolves to an orange liquid, which becomes turbid and purplish, and finally of a pale red colour.

Strychnine dissolves to a colourless fluid, and affords successively a clear yellow and a colourless liquid.

Brucine gives first a pale amethystine solution, then orange-yellow, or red-yellow looking across the tube and red on looking down it; on further solution an amethyatine red, becoming pale, but still distinct, at the end of a fortnight.

Caffein gives successively a colourless, a bright yellow, and a colourless fluid.

Piperin dissolves to a deep red, nearly black, fluid, with a flocky deposit on heating with Fe_2Cl_6; the addition of water gives a yellow fluid, the deposit appearing dark brown; the fluid was nearly colourless the next morning.

Betulin gives a dirty green-brown fluid, becoming clear and colourless with water.

Coumarin gives an orange-yellow clear fluid, which water renders very pale yellow.

Phloridzin (from bark of stem and roots of the apple-tree) dissolves to a blood-red liquid, which is orange-coloured at first, if very little of the substance is used: water gives a small flocky precipitate, and leaves the solution of an orange colour.

Quinine sulphate, of commerce, dissolves to a pale yellow fluid, which turns deeper yellow when warmed with Fe_2Cl_6, and colourless with water.

Cinchonin, impure, gives clear yellow, turbid yellow, and yellowish liquids.

Beburin sulphate, in brown scales, dissolves to a very dark liquid, becoming red with more H_2SO_4; with Fe_2Cl_6 and warming, a dark green fluid—as seen over white paper—is produced, which gives with water a dirty yellow liquid.

King's College, Windsor, N.S.,
May 25, 1878.

Analysis of Tin Crystals.—MM. Goppelsroeder and Trechsel add to the salt of tin, in a hot solution, a known quantity of chromate of potassa, which converts it into stannic chloride. They decompose the excess of chromate with hydrochloric acid, pass the chlorine evolved into a solution of potassic iodide, and titrate the iodine set at liberty with sodic hyposulphite. Otherwise they dissolve the salt of tin after the addition of a known quantity of chromate and hydrochloric acid. When the reaction is concluded they add potassic iodide in excess, and after five minutes they titrate with hyposulphite.—*Zeitschrift für Analytische Chemie.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 6, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the confirmation of the minutes of the preceding meeting the following certificates were read for the first time:—J. J. Watts, J. Treharne, E. W. Napper, and P. H. Walsh.

The first paper was read by Dr. GLADSTONE; it was entitled "*Analogies between the Action of the Copper-Zinc Couple and Occluded and Nascent Hydrogen*," by J. H. GLADSTONE, F.R.S., and ALFRED TRIBE. The authors have recently shown that finely divided copper charged with hydrogen converts nitre into potassium nitrite and ammonia; they have since found that hydrogen, in association with the same metal, reduces potassium chlorate to the chloride. They have observed that the copper-zinc couple in the presence of water converts nitrobenzol into aniline, a reaction which the authors have utilised for the detection of small quantities of nitrobenzol as follows:—"Add some 12 drops of strong copper sulphate solution to 3 or 4 pieces of zinc-foil (1" × ¼) in about 5 c.c. of water; wait till the liquid is completely decolourised, pour off the zinc sulphate solution, and wash the conjoined metals three or four times with water. Now add to this couple the nitrobenzol in solution or in suspension in water, heat nearly to boiling for about two minutes, filter, cool, and add drop by drop a solution of bleaching-powder. The nitrobenzol in 5 c.c. of a 0·05 per cent solution in water can thus be detected." The present paper contains chiefly the results of the authors as to the actions of palladium-hydrogen, platinum-hydrogen, and carbon- (cocoa-nut charcoal) hydrogen, on the substances enumerated in the table appended, which gives the principal reactions observed.

Substances Employed in Aqueous Solutions.	Substances Produced by—				
	Copper Zinc Couple.	Palladium-Hydrogen.	Platinum-Hydrogen.	Copper-Hydrogen.	Carbon-Hydrogen.
Potassium chlorate	Chloride	Chloride	Chloride	Chloride	Chloride
„ nitrate	Nitrite and ammonia*	Nitrite and ammonia*	Nitrite and ammonia?	Nitrite and ammonia	No action
„ Ferricyanide	Ferrocyanide	Ferrocyanide*	Ferrocyanide		Ferrocyanide
Nitrobenzol	Aniline	Aniline	Azobenzene		
Indigo, in presence of weak potash	White indigo	White indigo			
Sulphurous acid	Sulphur	Sulphuretted hydrogen	Sulphur?		
Arsenious acid	Arseniuretted hydrogen	Arsenic	Arsenic		

The results marked * have been obtained by previous observers.

In conclusion the authors draw attention to the close analogy between the action of the copper-zinc couple, of occluded and of nascent hydrogen in some cases, and point out that the results corroborate their previous view that the power of the copper-zinc couple depends to a great extent on the hydrogen absorbed by the finely divided metal. They also discuss the various explanations of the above reactions. The paper was illustrated by some experiments, which were performed by Mr. Tribe.

Dr. RUSSELL took the chair during the reading of the above paper.

The next paper was read by Dr. WRIGHT, "*On the Alkaloids of the Aconites*," Part III., by C. R. A. WRIGHT and A. P. LUFF. The authors find that aconitin is readily dehydrated by heating in contact with acids (preferably tartaric), forming apo-aconitin,—

$$C_{33}H_{43}NO_{12} = H_2O + C_{33}H_{41}NO_{11}.$$

The new base closely resembles the parent alkaloid, and is formed from it during extraction to some extent. Its hydrobromide appears to be more soluble than aconitin hydrobromide, as the mixture of bases yields pure aconitin on conversion into hydrobromide, re-crystallisation, and regeneration of the alkaloid. By saponification aconitin splits up—

$$C_{33}H_{43}NO_{12} + H_2O = C_7H_6O_2 + C_{26}H_{39}NO_{11},$$

forming benzoic acid and a new alkaloid, aconin, readily soluble in water and chloroform, insoluble in ether. Probably the substances described as napelline and acolycine by Hübschmann are aconin more or less pure. On treating aconitin with acetic or benzoic anhydrides it loses water, and forms a derivative in which H is replaced by an acid radical; thus, acetyl-apo-aconitin,—

$$C_{33}H_{40}(C_2H_3O)NO_{11},$$

and benzoyl-apo-aconitin, $C_{33}H_{40}(C_7H_5O)NO_{11}$, are obtained. On treating aconin with benzoic anhydride it gives the same product as that formed by aconitin, so the formula of aconitin is indicated as—

$$(C_{26}H_{35}NO_7)\begin{matrix}OH\\OH\\OH\\OCOC_6H_5\end{matrix}$$

apo-aconitin being—

$$(C_{26}H_{35}NO_7)\begin{matrix}=OH\\-OH\\-OCO,C_6H_5\end{matrix}$$

and aconin being—

$$C_{26}H_{35}NO_7\begin{cases}OH\\OH\\OH\\OH\end{cases}$$

Dibenzoyl-apo-aconin or benzoyl-apo-aconitin has the formula—

$$C_{26}H_{35}NO_7\begin{matrix}=O\\-OCOC_6H_5\\-OCOC_6H_5\end{matrix}$$

Similarly pseudaconin gives rise to analogous derivatives, the dibenzoyl and diacetyl bodies having been prepared. Picraconitin splits up on saponification into benzoic acid and a new base picraconin (much resembling aconin), $C_{31}H_{45}NO_{10} + H_2O = C_7H_6O_2 + C_{24}H_{41}NO_9$. Besides crystallisable aconitin *A. napellus* yields a considerable quantity of non-crystalline alkaloids, which contain more carbon and are of lower molecular weight than aconitin. These are probably formed from aconitin by alteration during extraction. One conclusion to which the authors call special attention, drawn from the above research, is that no practical difficulty exists in preparing from *A. ferox* and *A. napellus* well crystallised salts or alkaloids of constant composition and high physiological activity, whence it is evident that the amorphous preparations, now sold as aconitin, which vary immensely, should be replaced by pure crystallised alkaloids. The commercial product often contains 40 and even 80 to 90 per cent of uncrystallisable bases more or less inert.

The next paper was "*On the Alkaloids of the Veratrums: Part I., Alkaloids of Veratrum Sabadilla* (Assagræa officinalis), by C. R. A. WRIGHT and A. P. LUFF. The authors discuss the results obtained by previous observers —Couerbe, Merck, Weigelin, Schmidt, and Köppen. The discrepancies observed between the results of these chemists are due to the alteration and decomposition of the original bases during the processes of extraction and purification. The authors have examined the alkaloids obtained from *V. Sabadilla* seeds by percolating the crushed seeds with alcoholic tartaric acid, evaporation, separation from resin, and extraction by numerous and prolonged shakings with ether. The alkaloids obtained were three—(1) Veratrine (Couerbe), $C_{37}H_{53}NO_{11}$. On saponification it splits up $C_{37}H_{53}NO_{11}+H_2O=C_9H_{10}O_4+C_{28}H_{45}NO_8$ (dimethyl-protocatechuic acid being formed: this acid is identical with Merck's veratric acid and the acid obtained by similar treatment from pseudaconitin), and a new base, Verin. The authors propose to restrict the name "Veratrin" to the above alkaloid. It does not crystallise, but its sulphate and hydrochloride can be obtained in the crystalline state. (2) Cevadin (veratrin of Merck), $C_{32}H_{49}NO_9$. This alkaloid was obtained by Merck and Schmidt and Köppen, who assigned to it slightly different formulæ. Weigelin also obtained this substance in a very impure condition. On saponification it splits up—

$$C_{32}H_{49}NO_9+H_2O=C_5H_8O_2+C_{27}H_{43}NO_8,$$

forming a new base, Cevine, and an acid identified as methyl-crotonic acid, and with the cevadic acid of Pelletier and Caventon. The benzoyl compound is beautifully crystalline. The formula of cevadin is probably—

$$(C_{27}H_{41}NO_6)\begin{matrix}-OH\\-O.COC(CH_3)=C_2H_2,\end{matrix}$$

and is probably closely connected with the aconite alkaloids. (3) A new base; amorphous, yielding no crystallisable salts, and forming cevadic acid on saponification, having a a formula $C_{34}H_{53}NO_8$. This body resembles to a certain extent Weigelin's sabadilline, but in other respects is quite dissimilar. The authors propose to call it *Cevadilline*. No trace of anything like Weigelin's sabadillin could be detected. A commercial product sold as "sabadillin" consisted chiefly of cevadillin. The above papers contain the details of forty to fifty analyses and quantitative determinations.

Dr. GLADSTONE said the Society had to thank the authors for the large amount of labour which they had bestowed on a subject of much difficulty, and for the positive knowledge which was now gained of substances, most undesirable to work with, in place of the varying statements hitherto published.

In answer to Mr. MAXWELL LYTE, Dr. WRIGHT said that the above alkaloids gave for the most part colour-reactions with sulphuric acid, but it was difficult to distinguish the colours when a small quantity of the alkaloid was present with much organic matter.

The next paper was by Mr. J. W. THOMAS, "*On the Action of Hydrochloric Acid upon Chemical Compounds.*' It was read by the Secretary. The author has studied the action of hydrochloric acid on various substances in three ways:—(1) Chemical compounds were introduced into tubes containing hydrochloric acid gas standing over mercury. (2) A current of dry hydrochloric acid was passed over chemical compounds placed in a glass tube. (3) Chemical compounds were dissolved in water, and different proportions of hydrochloric acid added, and then distilled over a water-bath at 100°, or in a vacuum at 15° or 30°. By these methods the action of hydrochloric acid on many salts has been examined. The list includes various nitrates, tartrates, citrates, chromates, antimoniates, hypochlorites, sulphates, permanganates, ferrocyanides, oxalates, &c., in all about thirty salts.

The next paper was "*On the Action of Oxides on Salts (Part I.),*" by E. J. MILLS, D.Sc., and D. WILSON. It was read by the Secretary. The object of the present research is to determine the law, in consequence of which the action of oxides on salts leads in general to the formation of other oxides derived from the salts in question. The authors have investigated at present the action of tungstic, silicic, and titanic oxides on potassic carbonate at a high temperature by determining the loss of weight (from the escape of CO_2) during ignition. The reactions have been studied with great care, and corrections for various errors carefully made. The authors give several formulæ deduced from their experimental results. One of the results arrived at is that the chemical effect of an oxide and a carbonate acting on one another under the conditions specified is directly proportional to the product of their active masses, and inversely proportional to the sum of their residues. The authors conclude their paper with the following inference:—"That Brodie's fundamental equation represents the mutual action of two bodies under unit conditions, apart from change of weight, and with the unit of chemical effect."

The next paper was read by Dr. SENIER, "*On a New Test for Glycerin,*" by A. SENIER, M.D., and A. J. G. LOWE. This test is founded on the fact observed by Iles that borax when treated with glycerin gives to a Bunsen flame the green colour characteristic of boracic acid. The test is thus applied by the authors. The solution is rendered slightly alkaline by dilute soda, and a borax bead placed in it for a short time. The bead is then held in a Bunsen flame. If the solution contains 1 per cent of glycerin a distinct reaction is observed (erythrite and glycol give the same colour), or a little of the solution is mixed with some powdered borax, and some of the mixture placed on a platinum loop, and heated as before. By means of this test, after concentration, &c., one-tenth of a per cent of glycerin was detected in beer; 1 per cent in sherry; 1 per cent in milk; 5 per cent in treacle.

During the reading of the last papers Mr. Warington occupied the chair.

The last paper was read by G. S. JOHNSON, "*On Ammonium Tri-iodide.*" The author has prepared this substance—(1) By dissolving iodine to saturation in a strong aqueous solution of ammonium iodide; and (2) by stirring crystals of ammonium iodide and iodine with a small quantity of water till the resulting black liquid refused to dissolve more of either ingredient. The liquid was evaporated over sulphuric acid, and in a few days crystallised. No iodide of nitrogen was formed. This substance is more stable than the corresponding potassium salt. NH_4I_3 crystallises in dark blue prisms, usually tabular and isolated. It is soluble in a small, but decomposed (with deposition of iodine) by a large quantity of water; slightly deliquescent; when heated loses iodine, and becomes coated with NH_4I without fusing. Specific gravity of crystals, 3·749; atomic volume, 103·07.

Specimens of the alkaloids obtained by Wright and Luff and of ammonium tri-iodide were exhibited; also some combustion furnaces from Messrs. Bel.

After the thanks of the meeting had been given to the authors for their respective papers, the Society adjourned to June 20.

PHYSICAL SOCIETY.

June 8, 1878.

Prof. W. G. ADAMS, President, in the Chair.

THE following candidate was elected a member of the Society:—Mr. R. H. Solly.

The SECRETARY read a paper by Prof. HUGHES "*On the Physical Action of the Microphone.*" That instrument renders it possible to introduce into an electrical circuit an electrical resistance which varies in exact accord with sonorous vibrations, so as to produce an undulatory current of electricity from a constant source whose wavelength, height, and form is an exact representation of the sonorous waves. Prof. Hughes has found that when an

electrically conducting matter in the form of powder, filings, or superposed surfaces, is put under a certain slight pressure, far less than that which would produce cohesion, and more than would allow it to be separated by sonorous vibrations, a remarkable state of things occurs, the electrical resistance being caused to vary by re-arrangements as regards the form, number in contact, or pressure of the molecules. It is essential that the instrument be so arranged as regards pressure between the touching surfaces as to be adapted to the particular vibrations employed: thus a box suitable for a man's voice is not adapted to observe the tramp of a fly. But in all cases a perfect undulatory current can be secured throughout a certain range; and when speaking to the instrument a galvanometer should be interposed in the circuit, and the pressure between the surfaces gradually increased from a minimum until the needle remains stationary, when a maximum of loudness will be attained. Beyond this point the sounds die out gradually until there is complete silence. Prof. Hughes then proceeded to consider the probable cause of the observed phenomena, taking as an illustration the very simplest form of instrument—two blocks held together by an insulated adjusting-screw, the lower block being fixed to the board by means of which it receives the sonorous vibrations. From numerous experiments he inclines to the belief that the whole block increases and diminishes in size at all points, both in the centre and at the sides, in accordance with the form of the sonorous wave, and that this increase in size varies the resistance by changing—(1) The pressure at the surface of discontinuity; and (2) the extent of the molecular surfaces in contact. Of these changes he considers the latter has the greatest effect, since some of his best results have been obtained by using two surfaces of solid gold, and not by such an elastic conductor as metallised silk, which would be most affected by the first-named change. As evidencing the great mechanical effect produced by this uprising of the molecules, he mentioned that, when a large musical box was playing, one ounce of lead did not suffice to maintain two surfaces of 1 square c.m. in contact until the box was placed several feet distant. Prof. Hughes is now mainly anxious to find some efficient insulator for sounds, as, until such is available, it will be impossible to isolate and study many objects which require investigation from this new point of view. Prof. Hughes himself then exhibited some of the remarkably simple appliances he has used in his investigations. A very small clock, placed on a small drawing-board which carried a microphone, was used to interrupt a current passing through a telephone, and the tick was immediately audible through the whole room. A very remarkable effect was then shown. The microphone attached to this board being still connected with the telephone, which, being provided with a bell-mouth, enabled the audience to hear the sounds produced, a second telephone was introduced into the circuit and laid on the board, when a continuous sound was at once produced. This, Prof. Hughes explained, would last as long as the battery continued in action, and its explanation is as follows:—The act of placing the telephone on the board set up a vibration in the microphone; this passing to the bell-mouthed telephone set the second telephone in action, was returned to the board, and again passed, through its action, to the microphone. Hence the action is self-supporting, and it solves in a most perfect manner the question of a relay for the human voice in telephony; for it becomes only necessary to provide such an arrangement at each station for a speech to be both received and transmitted to any number of succeeding stations. The system is perfectly duplex, for if two correspondents speak into microphones and use telephones for receiving, each can hear the other, but his own speech is inaudible, and if each sing a different note no chord is heard. Experimenting on deaf persons, he finds that they can be made to hear the tick of a watch but not human speech, and his results have led him to conclude that we only hear ourselves speak through our bones and not through our ears.

Finally, Prof. Hughes illustrated Sir Henry Thompson's method of probing for shots, splinters, &c., by finding a very small shot in the midst of a piece of wash-leather.

Sir JOHN CONROY, Bart., M.A., read a paper "*On the Light Reflected by Potassium Permanganate.*" After referring to the results obtained by Haidinger and Stokes, and more recently by Weidemann, he proceeded to describe his own experiments, which have been made by means of a very complete Babinet's goniometer provided with a vertical as well as a horizontal stage, so that the reflecting surface could be placed directly over the axis of the instrument. Sunlight unpolarised or polarised in any plane by a Nicol was used, and the moving arm of the instrument carried a direct-vision spectroscope with a "bright-spot" micrometer and a reflecting-prism for bringing a second spectrum into the field. The colour of a surface, obtained by rubbing the crushed permanganate into a surface of ground glass with an agate burnisher, was found to vary with the nature of the light and its angle of incidence, and it further varied as the surface was immersed in benzene, bisulphide or tetrachloride of carbon. With light polarised perpendicular to the plane of incidence the dark bands in the reflected spectrum are far more distinct than when unpolarised or polarised perpendicularly to that plane. In the first of these three cases four bands are observed at angles less than 40°, and the blue end of the spectrum is very weak. As the angle of incidence increases the intensity of the blue rays diminishes; the dark bands gradually shift towards the blue end of the spectrum, and at about 60° a new band appears near D. With a still greater angle more of the blue rays are reflected and the bands fade away, those in the more refrangible part disappearing first. This displacement amounts approximately to 0·006 tenth-metre.

Prof. S. P. THOMPSON exhibited and described a cheap and efficient form of optical bench. Two straight oak bars, about 2 metres in length, are clamped together as in a lathe-bed, and a number of slides carrying various appliances slide easily without shake, and can be fixed in any position by wedges. The several frames carrying the diffraction grating or edges, the eye-piece (with an engraved glass micrometer), &c., are so made, in wood, as to be capable of adjustment in any plane, and the instrument can also be employed for making photometric and other similar measurements. The mean of two determinations for the wave-length of certain red light gave 0·000629 as compared with Fresnel's figure, 0·000640, while the total cost did not exceed £3.

The SECRETARY then read a paper by Prof. AYRTON, of the Imperial College of Tokio, Japan, "*On the Electrical Properties of Bees'-wax and Lead Chloride.*" The index of refraction of the former substance increases in passing from the liquid to the solid state, and it therefore seems important, in connection with the electro-magnetic theory of light, to carefully measure the specific inductive capacity of a condenser made of wax as it is cooled through its solidifying-point. The rise in capacity as the temperature falls from 80° to 60° C. is very striking, and the entire change was found to be in exact agreement with the changes known to occur in the index of refraction for light. An elaborate series of experiments was made, which sufficed to show that the results obtained were not due to any change in the distance apart of the plates (of copper) between which the wax was placed, caused by any shrinkage of this wax on solidifying. In consequence of a remark of M. Buff that lead chloride behaves as a metal, Prof. Ayrton has studied it as a dielectric, and he found a diminution of resistance by electrification; but as this result was not confirmed on subsequent experiment the question was more fully investigated, when he found that with an electromotive force under 1·75 volts. there is an increase in resistance, and above that amount there is a regular or irregular diminution. This limiting force is about that required to decompose water, and he concludes that the results obtained must be due to the damp contained in the lead chloride.

NOTICES OF BOOKS.

Water Supply of the State of New Jersey. Report by the Committee on Water Supply read at Meeting of New Jersey State Sanitary Association, held at Peinceton, October 17th, 1877. By Albert R. Leeds, Chairman. Reprinted from the *Journal of the Frankland Institute* for March and April, 1878. Philadelphia: W. P. Kildare.

We have yet much to learn concerning water. We refer of course not so much to the hydric oxide of the chemist, —a conception almost as absolutely ideal as the lines and points of the mathematician,—but to water as it actually exists in Nature, and still more in places where Nature has given way to human improvement; water holding in solution variable but important proportions of foreign matter, organic and inorganic, dead and living, and exercising no small influence upon animal life and upon man himself. We have yet, in great part, to discover when and why the streams and wells in any given region are unwholesome, and how any injurious properties are to be detected. We know, of course, that to make our streams the channels for removing excreta, animal and human, along with the varied refuse of industrial operations, is necessarily and indisputably evil. There are rivers—such as the Irwell, the Calder, the Aire, or the Sankey—which require no chemical examination to ensure their rejection for domestic purposes by any sane person. But there are waters inoffensive to man's senses which analysis pronounces suspicious. There are others which on scientific grounds appear doubtful, and which, sometimes used with impunity on other occasions, prove pernicious, and even deadly, if not to man, yet to cattle or to fish. Thus a paragraph is at present "going the round of the papers" concerning certain poisonous lakes in the interior of Australia, which, if drank by horses or oxen, generally prove fatal. These lakes certainly receive no manufacturing refuse, no drainage from cesspools or sewers; they contain, doubtless, as do woodland pools generally, a considerable proportion of decomposing vegetable matter; but why do their waters exert so peculiar and specifically destructive an action?

Again, it is stated that in certain rivers of Scotland, and we believe of Cumberland also, an unexplained disease has appeared among the salmon, which are dying off in multitudes, to the great discomfiture of the riparian proprietors, of the angling fraternity, and of all lovers of fish. The salmon are attacked by a whitish fungoid growth, which appears first in the head, then in the tail, and finally on the fins. We can scarcely believe that the rivers in question have since 1877 received any pollution, either novel in kind or increased in quantity. The general dulness of manufactures and the increased vigilance of the authorities concerning the pollution of rivers all point rather in the opposite direction. What, then, can be the cause of this sudden epizootic?

A similar mortality occurred during last summer among the fish in the Passaic, to the no small alarm of the population using the waters of this river for domestic purposes. From a careful consideration of the circumstances of this disease, Prof. Leeds concludes that it was due not to the poisonous dye-wares, acids, &c., but to an abnormal development of vegetation of a low type, favoured by the unusually low temperature and the prolonged drought. He suggests that such vegetable growths may produce substances which act upon fishes as specific poisons, and that by their decay the water may be deprived of the supply of dissolved oxygen necessary for the life of the fish. This hypothesis seems to us to carry with it a strong amount of probability, but before it can be regarded as established no small quantity of chemico-biological research will be required. Such investigations will be of the utmost importance to sanitarians. Much good might result if the methods used in this country for the determination of the organic impurities of waters were supplemented by those recommended by M. Gerardin in a memoir crowned by the Académie des Sciences. His three principles are—1. A determination of dissolved oxygen by the "hydrosulphite" process (Schützenberger and Gerardin's). 2. An observation of green plants and aquatic Mollusca. 3. A microscopic examination of Algæ and Infusoria. The results of these three methods of examination are said to be concordant. A clear water, inhabited by fishes and supporting such plants as the water-cress, was found comparatively rich in oxygen. Where oxygen is deficient the higher forms both of animal and vegetable life disappear, and in their place are found organisms of low type. This process appears to have its well-marked gradations. Thus above Rheims the River Vesle was clear, abounding in fishes, charas, water-cress, iris, &c., and containing 1 cubic inch of oxygen per cent. As soon as it received the refuse of some dye-works in the suburbs of Rheims, fish and water-cress disappeared, and in their stead came *Sparganum simplex*. After the influx of the principal sewers of Rheims the oxygen had fallen to 0·05 cubic inch. Two Algæ, *Beggiatoa alba* and *Oscillaria natans*, were largely developed. At Macan the oxygen had increased to 0·74 cubic inch, and a whitish Alga known as *Hypheothrix* covered the bed of the river. At Compensé this, too, had ceased, and the *Sparganium simplex* flourished again. Following the stream still farther, the increase in the amount of oxygen and the change in the vegetation were simultaneously progressive; and at Braisne the water contained again 1 cubic inch of oxygen per cent, whilst fish and water-cress flourished just as they did above Rheims. Thus in the course of 37½ miles a river was observed to be clean, polluted, and clean again, its purification having been effected by natural agencies. The various stages of pollution were marked by the successive appearance of *Sparganium*, *Spirogyra*, *Hypheothrix*, *Beggiatoa*, and *Oscillaria*, and the progressive steps to improvement by their reappearance in an inverse order.

Our author quotes also, from Prof. W. G. Farlow, some interesting remarks on the development of Algæ in polluted waters, especially *Beggiatoæ*, *Oscillariæ*, *Anabænæ*, &c., which give off most offensive odours: that of *Plectonema*, when decaying, is compared to the smell of a pigsty. Prof. Leeds very justly remarks that these investigations concerning the fresh-water Algæ, and their connection with and inter-dependence upon the animal life of streams and upon their dissolved oxygen, are of great importance. Upon them the solution of many unsolved problems of water-pollution and water-purification largely depends."

In conclusion, the author gives it as his opinion that, "whilst admitting the great value of the albuminoid ammonia process in many cases, yet there is much reason to believe that an organic analysis of the residue affords a safer ground of comparison." We are not absolutely satisfied with either process, and think that a fully satisfactory method of water-analysis lies still hid in the future. Prof. Wanklyn has, indeed, made some recent discoveries concerning the determination of organic matter dissolved in water; but as he has taken the extraordinary step of protecting his new process by a patent, the chemical public must wait for six months before the details become known, and in all probability for fourteen years before the method can receive that thorough and practical scrutiny which can alone decide upon its merits.

The pamphlet of Prof. Leeds, brief as it is, must be pronounced a weighty contribution to sanitary science.

Handels-Bericht vom Monat April, 1878, von Gehe & Co., in Dresden. (Trade Report for the month of April, by Gehe and Co., of Dresden.)

A very carefully prepared and useful trade-list of drugs and chemicals, to which is prefixed an elaborate dissertation on the present chronic depression of trade and its causes.

A Key to Organic Materia Medica, &c. By Dr. JOHN MUTER, M.A., F.C.S., Director of the South London School of Pharmacy. Second Edition. Simpkin and Marshall. 1878.

THE second edition of Dr. Muter's excellent manual is a vast improvement on the first, which was issued some four years back. The work has been enlarged from 140 to 480 pages, and contains everything that an ordinary student should know, and much more. As an introduction to Hanbury and Flückiger's "Pharmacographia" it will be found of great service to those pharmacists—and there are many of them—who wish to acquire a deeper knowledge of Materia Medica than is required by the magnates of Bloomsbury Square. The former work was simply a descriptive catalogue of Dr. Muter's own museum, the arrangement being in accordance with the contents of the drawers to be examined by his students. This method of classification has been entirely done away with, and the different products are now described in their botanical and zoological order. The source, method of collection, description, uses, chemistry, and pharmacology of each substance are given in clear and concise terms, which shows the practised teacher. Dr. Muter's method of observing, measuring, and classifying starches as given in the Appendix is an excellent one. The book is printed in large legible type, and the index, which has been compiled by Mr. Joseph Ince, is particularly copious, and would have pleased even the late Lord Campbell. We can highly recommend this work to our pharmaceutical readers.

The Mineralogical Magazine, &c. Vol. II., No. 8. Simpkin and Marshall. March, 1878.

THIS excellent magazine—which, in addition to much other interesting matter relating to the collection and classification of minerals, contains the *Transactions* of the Mineralogical Society—has a capital number for the beginning of the new volume. The papers by Mr. Sorby, the President of the Society, "On the Determination of the Minerals in their Sections by their Indices of Refraction;" by Professor Bonney, "On the Gabbro of the Pennine Alps," and the beginning of a series by Professor Heddle "On the County Geognosy and Mineralogy of Scotland," may be read with interest and profit by both the chemist and the mineralogist. We are glad to see that the Mineralogical Society is in a very flourishing condition. Two plates accompany each number, the date of issue being at intervals of about three months, the last number having appeared in March.

CORRESPONDENCE.

ANALYSES OF RUSSIAN IRON.

To the Editor of the Chemical News.

SIR,—Mr. E. Riley remarks (CHEM. NEWS, vol. xxxvii., p. 226) that he is astonished that most of the steels the analyses of which appeared in my late paper (CHEM. NEWS, vol. xxxvii., p. 199) contain only traces of Ph and S. He also remarks that the percentage of Mn is too low (unusually?) in the analyses, and that I perhaps use inferior methods for the detection of Ph, S, and Mn.

The following are my answers:—

1. The steels in question were prepared from Oural pig-irons; most of them, indeed, contain only *traces* or *nil* of Ph and S. Charcoal is used as a fuel.

2. The methods I use belong to Eggertz, and may be found in his classical manual "Om Kemisk profning af Jern, Jernmalmer och Braenn materialier." Using the methods of the well-known professor, V. Eggertz, I cannot understand why I should prefer other methods.

3. As for the low percentage of Mn, I will only mention that I cannot understand what Mr. Riley wishes, as it is not my fault that the Russian steels contain such a low percentage of Mn.—I am, &c.,

SERGIUS KERN, M.E.

St. Petersburg, 48, Rue aux Pois,
June 7, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris, No. 6, March 20, 1878.

Solubility of Certain Organic Acids in Alcohol and Ether.—E. Bourgoin.—It is maintained that tartaric acid is insoluble in ether, whilst the organic acids most nearly approaching it are soluble in that liquid. The author having found that this exception does not exist, has compared the respective solubilities in alcohol and ether of the following acids:—Oxalic, succinic, tartaric, citric, gallic, benzoic, salicylic, and phthalic. His results are embodied in the following table:—

Acids.	Ether.	Absolute Alcohol.	Alcohol at 90 per cent.
Oxalic	1·266	23·730	14·700
Succinic	1·265	7·510	12·590
Tartaric	0·400	25·604	41·135
Citric	2·260	75·900	52·850
Gallic	2·560	38·790	23·310
Benzoic	31·350	46·680	41·620
Salicylic	50·470	49·630	42·090
Phthalic	0·684	10·080	11·700

Synthesis of Phthalic Acid.—A. Guyard.

New Method of Precipitating the Gold contained in Old Toning-Baths.—F. Haugh.—The baths when no longer fit for use are filtered into a white glass flask, rendered alkaline with a little bicarbonate of soda, and a concentrated alcoholic solution of magenta is added drop by drop until the liquid has taken the deep red hue of syrup of raspberries. The flask is then exposed for six to eight hours to the light of a bright window. At the end of this time the gold is found to be deposited as a violet powder, whilst the supernatant liquid has become colourless. It is carefully decanted, so as to preserve merely the deposit. When a sufficient quantity of protoxide of gold has thus been collected, it is carefully washed upon a filter, dried, and the filter is burnt. The dry residue and the ash of the filter are then dissolved at a gentle heat in an excess of *aqua regia*, and the solution—diluted with distilled water—is separated from the insoluble substances by filtration.—*Chem. Centralblatt*, viii., 201.

Process for the Preparation of Guignet's Green.—A. Scheurer-Kestner.—Analysis having shown that Guignet's green is merely a hydrate of chrome formed by the decomposition of a chromo-potassic borate in the presence of water, the author has sought to produce a simple chromic borate in the hope of forming Guignet's green by its decomposition. On igniting a mixture of ordinary chromic hydrate and boric acid in the proportion of five to six parts of the crystalline acid to one part of the anhydrous chromic oxide a green, partially fused mass is obtained. This mass, on contact with water, becomes heated, and is resolved into hydrated oxide (Guignet's green), which is precipitated, and boric acid, which is dissolved. Theoretically, this experiment has a certain importance, since it establishes with certainty that potash plays no part in the ordinary process.—*Bull. de la Soc. Indus. de Mulhouse.*

No. 7, April 5, 1878.

Dissociation of Sulphides in Presence of Boiling Water, as well as at Temperatures below 100°.—MM. de Clermont and de Frommel.—The authors find that certain hydrated sulphides on boiling are dissociated into hydric sulphide on one hand and oxide on the other. This phenomenon has been observed in case of most sulphides, with the exception of those of copper, bismuth, and mercury. They have not been able to draw out the general law of this reaction, the transformations of the sulphides in presence of water being very complex. Arsenic trisulphide is dissociated on boiling into hydric sulphide, which escapes, and arsenious acid, which remains in solution. This fact has led them to a new process for the separation of arsenic in presence of other metals, espacially tin, antimony, gold, platinum, and all the other metals whose sulphides are decomposable by boiling water. They proceed as follows:—The mixed sulphides are suspended in water, and raised to a boil. The arsenic sulphide is rapidly disssociated, ebullition for twenty to twenty-five minutes being for 5 to 6 centigrms. of sulphide. All the sulphides except that of arsenic yield insoluble oxides which may be removed by filtration from the soluble arsenious acid, which may then be determined by ordinary methods. The same process is applicable to the separation of arsenic acid.

Composition of the Mineral Waters of Aix, in Savoy, and of Marlioz.—E. Willm.

Composition of the Sulphuro-bromo-ioduretted Waters of Challes.—E. Willm.—Two papers of considerable length, and of medical rather than chemical interest.

Substitution of Sulphur for Oxygen in the Fatty Series.—A. Dupré.—Hitherto only acids have been obtained in which one of the three atoms of oxygen is replaced by sulphur. The author has endeavoured to replace all three.

New Method of Preparing Normal Dimethyl-Ethylen.—MM. Le Bel and Greene.—Normal dimethyl-ethylen is formed in the action of $ZnCl_2$ upon butylic alcohol at elevated temperatures.

Pyrogenous Derivative of Tartaric Acid, Dipyro-tartaric Aceton.—E. Bourgoin.—The author remarks that the dry distillation of this acid has hitherto yielded merely two compounds, the pyruvic and pyro-tartaric. He has succeeded in obtaining a third, of greater molecular complication, which he names dipyro-tartraceton, and which is neutral, very slightly soluble in water, but soluble in alcohol, ether, sulphide of carbon, and chloroform.

Derivatives of Quercite, obtained by means of Hydrochloric Acid.—L. Prunier.—Concentrated hydrochloric acid dehydrates quercite, producing quercitan, or rather its hydrochloric derivatives.

New Colouring Matter derived from Mono-nitro-alizarin, and known as Blue Alizarin.—M. Prud'homme.—Already noticed.

Procedures for the Restoration of Writing Effaced by Time.—E. von Bibra.—The author proposes to moisten the writing with a moderately concentrated solution of tannin, the excees of which is then removed by the application of the washing-bottle, and the paper dried at 65°.

Process for Seasoning New Casks.—E. von Bibra.—The author proposes to eliminate all soluble matter from the interior of the staves by the use of crystals of soda, of which 1 kilo. is used per hectolitre of the contents. The cask is first filled two-thirds full of clean water, the proper quantity of solution of soda is added, and after the liquid is mixed the cask is filled to the bung. After standing for ten or twelve days the alkaline liquid is run out, and the cask repeatedly rinsed with clean water.

New Discharge for Vat-Blues.—Oscar Scheurer.—The author prints on minium, and passes through weak hydrochloric acid, thus obtaining white designs very clear and well defined. Chrome-yellow, vermilion, Guignet's green, or other insoluble colours, thickened with albumen, may be associated with the minium.

Conversion of Magenta into Aniline-Violet.—M. Vaucher.—The author observes that magenta dissolved in aldehyd takes on standing a violet-shade, the change at common temperatures going on for two months.

Certain Artificial Colouring Matters Fixed by means of Sulphur.—M. Vaucher.—The author finds that wool boiled in a solution of sodic hyposulphite in presence of sulphuric acid not merely attracts aniline-green, but gives fuller and brighter shades, with a number of artificial colours, among which are mentioned eosin, aniline-brown. phosphine, safranin, aniline-violet, &c.

Justus Liebig's Annalen der Chemie,
Band 191, Heft 3.

Ethylenlactic Acid.—E. Erlenmeyer.—The author has not succeeded in obtaining the ethylenlactic acid of Wislicenus, either by the processes given by that author or by Linnemann's method.

Researches on the Compounds Occurring in Crude Anthracen.—Dr. Othmar Zeidler.—In experimenting with a supposed pure material the author obtained results indicating that in addition to the well-known and more plentiful compounds, other substances were present which adhere obstinately to anthracen. In order to separate these compounds he had recourse to the action of solvents and fractionated crystallisation. The procedure adopted was a twice repeated extraction of the anthracen with water acidulated with sulphuric acid, in order to remove acridin. The residue was dried, extracted at an ordinary temperature with five-fourths of its weight of acetic ether, pressed, digested again with the same quantity of acetic ether, and the residue after pressure was washed upon the Bunsen pump with the same quantity of the solvent till the liquid running off was merely slightly yellow. Of the original 400 grms. 235 were dissolved. The acetic ether was then distilled off, and the residual brown cake submitted to distillation. The portion insoluble in acetic ether consists essentially of anthracen, along with chrysen and other bodies, and it has as yet not been submitted to further examination. The portion dissolved in acetic ether was next treated as follows:—It was extracted with warm alcohol at 40°, let cool, and filtered (filtrate No. 1). The residue was treated in a similar manner with benzol (filtrate No. 2). The residue was treated with a minimum of hot benzol and filtered without cooling (filtrate No. 3), whilst the residue upon the filter was marked No. 4. No. 1 contains carbazol, phenanthren, fluoren; No. 2 contains synanthren; No. 3 anthracen and pseudophenanthren, whilst the portion insoluble in benzol consists of carbazol. From the latter the author obtained a new derivative, nitroso-carbazol, which dissolves in sulphuric acid with a dark green colour, which, on the application of heat (100°), becomes a blue-green, whilst nitrous acid escapes. On the addition of water a dark green precipitate falls, partially soluble in water with a green colour, the solution turning to a dirty violet in presence of an alkali.

Speed of Molecules.—Fr. Wächter.—A mathematical paper, not suitable for abstraction.

Aniluvitonic Acid.—Dr. Carl Böttinger.—The author assigns to free aniluvitonic acid the formula $C_{20}H_{18}N_2O_4$.

Didymium and Lanthanum.—F. Frerichs and F. Smith.—The authors give their reasons for regarding these two metals as trivalent elements, and describe a great number of their salts.

Behaviour of Acrylate of Soda with Aqueous and Fused Alkaline Bases.—E. Erlenmeyer.—Acrylate of soda at the melting-point of dry hydrated potassa is not carbonised, but resolved into an acetate and a formiate.

Behaviour of Acetylen with Concentrated Sulphuric Acid.—Simon Zeisel.—From this investigation it appears that Lagermark and Eltekoff were in error when they believed that they had converted acetylen into crotonic aldehyd.

Biedermann's Central-blatt, Heft 12.

Organic Substances Capable of Producing Putrefaction in Water.—Prof. Gustav Bischof.—Taken from the CHEMICAL NEWS.

Absorptive Power of Soils.—Dr. W. Pillitz.—The quantities of potash and ammonia which are capable of being absorbed by the same quantity of the same soil are in proportion to the equivalents of these compounds. When earth saturated with sal-ammoniac was treated with solution of phosphate of potash, the absorption of the potash was affected, but not that of the phosphoric acid.

Disengagement of Oxygen from Green Twigs Submerged in Water Previously Boiled and Exposed to the Sun.—Prof. Jos. Böhm.—If fresh green shoots of *Ligustrum vulgare* are exposed to the sun-light under water previously boiled, they evolve much more oxygen than corresponds to the quantity of air contained in them before the experiment. This oxygen is chiefly derived from the carbonic acid thrown off from the substance of the twigs in consequence of internal respiration. On prolongation of the experiment, the development of gas becomes slower and slower, and ceases entirely in three or four days, although the shoots still appear fresh and healthy. If the same twigs are again exposed to the light in a fresh portion of boiled water, they merely give off at first a few bubbles of gas, and if the experiments are continued above a week, the green rind turns brown, and carbonic acid and hydrogen are evolved in consequence of butyric fermentation.

Ripening Process of Grapes.—E. Mach, Fr. Kurmann, and A. Schultz.—Mach concludes that the weight and diameter of grapes increase at first rapidly, till the time for the change of colour is near, after which the increase becomes slow. The absolute percentage of sugar increases at first slowly, but becomes rapid when the colouration begins. The quantity of free acid increases at first, but from the moment of incipient colouration, it decreases, both relatively and absolutely. Tannin is relatively most abundant at first, and disappears almost entirely at the time of colouration. Starch disapears on ripeness.

Deceptive Colouration of Wine with Magenta.—It is contended that wines containing even the smallest traces of aniline or phenol colours should be confiscated.

Reimann's Färber Zeitung, No. 18, 1878.

The hygroscopic property of cobalt chloride is utilised in a style of handkerchiefs now sold as "Foulard's baromètre." The design is a man carrying an umbrella, the latter being printed in chloride of cobalt. If the weather is fine and dry the umbrella appears blue, but turns grey on unsettled days, and becomes white in rain. The first washing removes the colour.

A variety of magenta has been introduced, which is quite unaffected by contact with acids.

Malachite green is a new dye, discovered by Dr. Oscar Döbner, and formed by the action of benzotrichloride upon methyl-aniline in presence of metallic salts. The colour in question is the only product of the reaction. It is calculated to be a very formidable rival to methyl-green, as it does not, like the latter, change its colour on the application of a boiling heat.

Les Mondes, Revue Hebdomadaire des Sciences, No. 1, May 2, 1878.

Remarks on the Radiometer.—M. Riecke.—The author establishes the equation of the movement of the radiometer; supposing this movement produced of a constant normal pressure upon the discs, and a friction proportional to the speed. Experiments made with two different radiometers gave for one a constant coefficient of friction, whilst in the other this coefficient increased with the speed. The pressures were respectively measured by 0·00002 and 0·00006 centimetres of water. The author examines the signification of this pressure as regards the emission theory.

On the Radiometer.—Prof. Cooke.—All the movements of the radiometer are explained by the theory of gases, without having recourse to any other hypothesis. The author caused to fall upon an ordinary radiometer, a beam of parallel rays, so as to illuminate the black surface alone, the white surface alone, or both together. The number of revolutions in the same time is 233, 88, and 319, the last number being evidently the sum of the two others. The movement is, therefore, produced by interior forces. Heating the glass globe gives a negative rotation. The radiometer may be regarded as a thermic machine; the black surface being the generator, and the case the refrigerant. He compares the intensities of two flames, the one luminous and the other non-luminous, placed successively at equal distances from a radiometer and a thermo-electric battery. The battery showed 0·311, and the radiometer 0·315. The movement is, therefore, an effect of heat.—*Sill. Journal*, xiv, 1877).

No 2, May 9, 1878.

Prof. Ricard, of Trchewan, apparently in Bohemia, describes an instance of the spontaneous rupture, or rather explosion, of a child's drinking-cup of toughened glass. The *Polytechnisches Notizblatt* adds that several such cases have lately occurred without any perceptible cause.

MEETINGS FOR THE WEEK.

TUESDAY, 18th.—Royal Institution, 3. "Minute and Low Forms of Life," Rev. W. H. Dallinger.
—— Zoological, 8.30.
WEDNESDAY, 19th.—Geological, 8
—— Meteorological, 7.
THURSDAY, 20th.—Royal 8.30.
—— Chemical, 8. "Contributions to the History of Naphthalene: II. β-Naphtha-quinon Derivatives," J. Stenhouse and C. E. Groves. "On Pyro-tri-tartaric and Carbo-pyro-tri-tartaric Acids," G. Harrow. "Laboratory Notes," H. E. Armstrong. "Octylie Alcohol and its Derivatives," E. Neison.
—— Philosophical Club, 6.30.
SATURDAY, 22nd.—Physical, 3. "Experiments with a New Polariscope," Prof. W. G. Adams. Starch and Unannealed Glass under the Polariscope," W. Baily. Equipotential Surfaces of a Conductor under Influence," Sir Frederick Elliott. "Complementary Colours," Dr. Gorham. "Flow of Water from Orifices at Different Temperatures," Prof. W. C. Unwin. "Co-ordination of Space," C. H. Hinton. "Magnetic Figures illustrating Electro-dynamic Relations," Prof. S. P. Thompson.

NOTES AND QUERIES.

Writing Fluid—I should be very glad if you would furnish me with a recipe for good writing-fluid—one that writes violet, and quickly changes to a deep black, that flows freely, and does not corrode steel pens.—H. Ross.

Testing Lemon Juice.—Can any of your readers inform me where I shall find a simple method of testing lemon juice intended for calico-printers' use to determine its genuineness? The citrometer of course gives the specific gravity, which is usually taken as an indication of the amount of citric acid present, but it seems that it may be considerably adulterated with other juices and acids, which render it undesirable for printers.—A DRYSALTER BUT A POOR CHEMIST.

THE

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Incorporated on the 2nd October, 1877, under the 30th and 31st Victoria, chap. 131, sec. 23.

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Alldred, C.H., F.C.S., 24, Duke Street, Grosvenor-square, W.
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Bassett, Henry, F.C S., 44, St. Paul's-road, N.W.
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Butterfield, J. C., F.C S., 106, Queen Victoria-street, E.C.

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Cameron, James, Laboratory, Somerset-house, W.C.
Cameron, J. M., F.C.S., 90, King-street, Hammersmith
Cammack, J., 50, Pecker's-hill, Sutton, near St. Helen's
Campbell, Dugald, F.C.S., 7, Quality-court, Chancery-lane
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Carteighe, Michael, F.C.S., 180, New Bond-street, W.
Caswell, C. B., F.C.S., 13, George-road, Birmingham
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Clark, John, Ph.D., F.C.S., 138, Bath-street, Glasgow
Claudet, F., F.C.S., 6 and 7, Coleman-street, E.C.
Cleaver, Edward Lawrence, F.C.S., 289A, King's-road, S.W.
Cleminshaw, E., F.C.S., King's School, Sherborne
Cloud, Thomas Charles, Wallaroo, South Australia
Clowes, Frank, D.Sc., F.C.S., Newcastle-undor-Lyme
Coleman, J. J., F.C.S., 13, Dundas-street, Glasgow
Cooke, Samuel, M.A., Civil Engineering College, Poona
Coomber, Thomas, F.C.S., 80, Kingsdown-parade, Bristol
Corfield, W. H., M.A., M.B., F.C.S., 10, Bolton-row, W.
Cownley, Alfred John, F.C.S., 106, Fenchurch-street, E.C.
Cranston, George, 22, Devonshire-street, Manchester
Crookes, William, F.R.S., V.P.C.S., 20, Mornington-road, N.W.
Crowder, William, 33, Clapton-square, Lower Clapton, E.

Dalziel, John Graham, United College, St. Andrew's, N.B.
Darby, Stephen, F.C.S., 140, Leadenhall-street
Darling, W. H., F.C.S., 126, Oxford-street, Manchester
Davies, Edward, F.C.S., Royal Institution, Liverpool
Davies, R. H., F.C.S., 6, Bradmore-park-terrace, Goldhawk-road, W.
Davis, George E., F.C.S., 87, Barton-arcade, Manchester
Davis, Henry Wilson, Laboratory, Somerset-house, W.C.
Day, James John, 18, London-street, Derby
Deacon, Henry Wade, Appleton-house, Widnes
De Chaumont, Francis S.B.F., Army Medical School, Netley
De la Rue, Warren, D.C.L., F.R.S., 73, Portland-place, W.
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Dupre, Auguste, Ph.D., F.R.S., Westminster Hospital, S.W.

Early, William, Trinity College, Dublin
Eltoft, Thomas, F.C.S., 55, Torriano-avenue, N.W.
Estcourt, Charles, F.C.S., St. James's-square, Manchester
Evershed, F., 8, Dalrymple-terrace, Glenarm-road, Clapton, E.

Fairley, Thomas, F.R.S.E., F.C.S., 16, East-parade, Leeds
Farries, Thomas, F.C.S., 16, Coleman-street, E.C.
Fenton, Henry J. H., Christ's College, Cambridge
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Field, Frederick, F.R.S., F.C.S., Hither-green-lodge, Lewisham, S.E.
Fletcher, Alfred, 5, Edge-lane, Liverpool
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Foster, William, B.A., F.C.S., Middlesex Hospital, W.
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Frankland, E., D.C.L., F.R.S., Royal College of Chemistry, South Kensington Museum, S.W.
Friswell, R. J., F.C S., 10, Clapton-square, E.
Fuller, William James, F.C.S., Bristol

Gale, Samuel, F.C.S., 338, Oxford Street
Galloway, Robert, M.R.I.A., F.C.S., Royal College of Science, Stephen's-green, Dublin
Gardner, J , F.C.S., 11, St. Paul's-crescent, Camden-square
Garrick, Andrew R., St. Helen's, Lanca-hire
Gatehouse, J. Wright, 36, Broad-street, Bath
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Gilchrist, Percy C., F.C.S., Blaenavon, Monmouthshire
Gladstone, J. H., Ph.D., F.R.S., 17, Pembridge-square, Hyde-park, W.
Glover, G. T., F.C.S., 30, Donegall-place, Belfast
Gordon, Joseph Gordon, F.C.S., 20, King-street, S.W.
Gore, George, F.R.S., Islington-row, Edgbaston, Birmingham
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Greenaway, A. J., F.C.S., 147, Upper-street, Islington, N.
Greenway, Thomas, The Sheffield Smelting Company, Sheffield
Gregory, H. R., 7, Quality-court, Chancery-lane, W.C.
Greville, H. Leicester, F.C.S., Bentinck-house, Stroud-green-road
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Gurney, H. S. Lewis, 11, Wilson-Patten-street, Warrington.

Blake, H. Wilson, Ph.D., F.C.S., Palsgrave-place, Temple, W.C.
Helse, William Edward, F.C.S., 21, Mincing-lane, E.C.
Hanbury, Cornelius, F.C.S., Plough-court, E.C.
Harkness, W., F.C.S., Laboratory, Somerset-house, W.C.
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Heaton, C. W., F.C.S., Charing-cross Hospital, W.C.
Hehner, Otto, F.C.S., 54, Holborn Viaduct
Helm, H. J., F.C.S., Laboratory, Somerset-house, W.C.
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Hodges, John Frederick, M.D., F.C.S., Queen's College, Belfast
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Howard, Thomas, F.C.S., 52, Swinton-street, Gray's-inn-road, W.C.
Howard, William Dilworth, Stratford, E.
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Huntington, A. K., Abbeville-house, Arkwright-road, Hampstead
Huskisson, Henry Owen, F.C.S., 42, Highbury-park, N.
Huson, C. W., 5, York-buildings, Dale-street, Liverpool
Hutchings, W. Maynard, Liscard, near Birkenhead
Huxley, James Henry, Crescent-road, Sharrow, Sheffield

Jackson, Edgar, 106, Queen Victoria-street, E.C.
Jarmain, George, F.C.S., 84, Northgate, Huddersfield
Johnson, George Stillingfleet, F.C.S., 11, Savile-row, W.
Johnson, Thomas H., F.C.S., 96, Duke-street, Liverpool
Jones, E. W. T., F.C.S., Wolverhampton
Jones, Francis, F.R.S.E., F.C.S., Grammar School, Manchester

Keates, Thomas William, 10, Spring-gardens, S.W.
Keane, James Boddely, 38, Hartham-road, N.
Keighley, Alfred Dudley, F.C.S., Old-hall, Milnthorpe
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Kingzett, C.T., F.C.S., 12, Auriol-road, West Kensington
Kitchin, Archibald, F.C.S., 27, King-street, Whitehaven
Kynaston, Josiah W., F.C.S., St. Helen's

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Müller, Hugo, Ph.D., F.R.S., 110, Bunhill-row
Muspratt, Edmund K., F.C.S., Seaforth-hall, near Liverpool

Napier, James, F.C.S., Gipping-cottage, Bramford, near Ipswich
Nelson, Edmund, F.C.S., Scientific Club, Savile-row, W.
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THE CHEMICAL NEWS.

VOL. XXXVII. No. 969.

THE RELAYING OF THE TELEPHONE.

By Profs. EDWIN J. HOUSTON and ELIHU THOMSON of Philadelphia.

UPON the first announcement of the invention of the Bell articulating telephone the authors have been busily engaged endeavouring to relay the telephone, or to cause it to act as a repeater for an independent circuit. The exceedingly minute movements of the diaphragm of the receiving telephone, however, rendered all our efforts unsuccessful in practice, until the news reached us of the discovery by Prof. Hughes of the delicate microphone. The inexpressible sensitiveness of this instrument to feeble sound waves enables it to respond to even the feeble movements of the diaphragm of the receiving telephone, and by its means we have been successful in relaying this instrument.

The means by which we have at last accomplished this result are briefly as follows:—A minute microphone, consisting essentially of three pieces of carbon, is attached directly to the plate of the receiving telephone. The carbon pieces are arranged as described by Prof. Hughes, viz., two horizontal pieces with cavities on the sides facing each other, and the third piece, furnished with sharp ends, inserted in these cavities.

The microphone thus arranged is placed in the circuit on which the telephonic message is to be repeated. Those acquained with the marvellous delicacy of the microphone will not be surprised to learn that it transmits the movements imparted to it from the diaphragm of the telephone as variations in the intensity of the electrical current traversing the microphone circuit, and therefore acts as a relay or repeater.

In a number of experiments tried on various telephone circuits, one telephone relay or repeater was found to act admirably, although no especial attempt was made to properly proportion resistances. A number of microphones being used instead of one, with the battery circuits properly connected the effects would undoubtedly be increased.

Central High School, Phila.,
June 6, 1878.

ON RELATIONS AMONG THE ATOMIC WEIGHTS OF THE ELEMENTS.

By JOHN A. R. NEWLANDS, F.I.C., F.C.S.

BESIDES the relations among the atomic weights of the elements when arranged in their natural order which are now comparatively well known in connection with the periodic law, there are others of considerable interest, some of which will be briefly alluded to in the present communication,

In Table I. four separate scales of atomic weights are given, the first row of figures being the atomic weights, taking hydrogen = 1; the second row, taking sodium = 10; the third, taking chlorine = 15, nearly; and the fourth, taking carbon = 5.

Starting with the ordinary atomic weights the sum total of those of the known elements is 6227·9, and this sum, divided by the number of elements in the Table, viz., 64, gives an average atomic weight of 97·31 for each element, when hydrogen is taken as unity.

TABLE I.

Symbol.	At. Wt.	At. Wt. ÷2·3 or Na=10.	At. Wt. ÷2·37 or Cl=15 nearly.	At. Wt. ÷2·4 or C=5.
H ..	1·0	0·435	0·422	0·417
Li ..	7·0	3·04	2·95	2·92
Be ..	9·4	4·09	3·97	3·92
B ..	11·0	4·80	4·64	4·58
C ..	12·0	5·22	5·06	5·00
N ..	14·0	6·09	5·91	5·83
O ..	16·0	6·96	6·75	6·67
F ..	19·0	8·26	8·02	7·92
Na ..	23·0	10·00	9·70	9·58
Mg ..	24·0	10·43	10·13	10·00
Al ..	27·4	11·91	11·56	11·42
Si ..	28·0	12·20	11·81	11·67
P ..	31·0	13·48	13·08	12·92
S ..	32·0	13·91	13·50	13·33
Cl ..	35·5	15·43	14·98	14·79
K ..	39·1	17·00	16·50	16·29
Ca ..	40·0	17·39	16·88	16·67
Ti ..	50·0	21·74	21·09	20·83
V ..	51·2	22·26	21·60	21·33
Cr ..	52·2	22·70	22·03	21·75
Mn ..	55·0	23·91	23·21	22·92
Fe ..	56·0	24·35	23·63	23·33
Ni ..	58·8	25·57	24·81	24·50
Co ..	58·8	25·57	24·81	24·50
Cu ..	63·4	27·57	26·75	26·42
Zn ..	65·2	28·35	27·51	27·17
Ga ..	69·9	30·39	29·49	29·12
As ..	75·0	32·61	31·65	31·25
Se ..	79·4	34·52	33·50	33·08
Br ..	80·0	34·78	33·76	33·33
Rb ..	85·4	37·13	36·03	35·58
Sr ..	87·6	38·09	36·96	36·50
Y ..	88·0?	38·26	37·13	36·67
Zr ..	89·6	38·96	37·81	37·33
Nb ..	94·0	40·87	39·66	39·17
Mo ..	96·0	41·74	40·51	40·00
Rh ..	104·4	45·39	44·05	43·50
Ru ..	104·4	45·39	44·05	43·50
Pd ..	106·6	46·35	44·98	44·42
Ag ..	108·0	46·96	45·57	45·00
Cd ..	112·0	48·70	47·26	46·67
In ..	113·4	49·30	47·85	47·25
Sn ..	118·0	51·30	49·79	49·17
Sb ..	122·0	53·04	51·48	50·83
I ..	127·0	55·22	53·59	52·92
Te ..	128·0	55·65	54·01	53·33
Cs ..	133·0	57·83	56·12	55·42
Ba ..	137·0	59·57	57·81	57·08
Di ..	138·0?	60·00	58·23	57·50
Ce ..	140·0?	60·87	59·07	58·33
Er ..	178·0?	77·39	75·11	74·17
La ..	180·0?	78·26	75·95	75·00
Ta ..	182·0	79·13	76·79	75·83
W ..	184·0	80·00	77·64	76·67
Au ..	197·0	85·65	83·12	82·08
Pt ..	197·4	85·83	83·29	82·25
Ir ..	198·0	86·09	83·54	82·50
Os ..	199·2	86·61	84·05	83·00
Hg ..	200·0	86·96	84·39	83·33
Tl ..	203·6	88·52	85·91	84·83
Pb ..	207·0	90·00	87·34	86·25
Bi ..	210·0	91·30	88·61	87·50
Th ..	235·0	102·17	99·16	97·92
U ..	240·0	104·35	101·27	100·00

The atomic weights at present known do not correspond to the natural order, but appear to be a multiple of the latter; so that any calculation which may be made with a multiple of the ordinal numbers may also be made, though somewhat roughly, with the atomic weights.

In Table II. the elements are arranged in sevens, the

TABLE II.

HORIZONTAL ARRANGEMENT IN SEVENS. AT. WT. ÷ 2·3, OR Na = 10·00.

No.		No.		No.		No.		No.		No.		No.	
		2. Li	3·04	9. Na	10·00	16. K	17·00	23. —	—	30. Cu	27·57	37. Rb	37·13	44. —	—
		3. Be	4·09	10. Mg	10·43	17. Ca	17·39	24. —	—	31. Zn	28·35	38. Sr	38·09	45. —	—
		4. B	4·80	11. Al	11·91	18. —	—	25. Fe	24·35	32. Ga	30·39	39. Y	38·26	46. —	—
		5. C	5·22	12. Si	12·20	19. Ti	21·74	26. —	—	33. —	—	40. Zr	38·96	47. Rh	45·39
		6. N	6·09	13. P	13·48	20. V	22·26	27. —	—	34. As	32·61	41. Nb	40·87	48. Ru	45·39
		7. O	6·96	14. S	13·91	21. Cr	22·70	28. Ni	25·57	35. Se	34·52	42. Mo	41·74	49. Pd	46·35
1. H	0·435	8. F	8·26	15. Cl	15·43	22. Mn	23·91	29. Co	25·57	36. Br	34·78	43. —	—	50. —	—

TABLE III.

HORIZONTAL ARRANGEMENT IN SEVENS AND TENS. AT. WTS. ÷ 2·37, OR Cl = 15 NEARLY.

No.		No.		No.		No.		No.		No.	
		2. Li	2·95	9. Na	9·70	16. K	16·50	26. Cu	26·75	36. Rb	36·03
		3. Be	3·97	10. Mg	10·13	17. Ca	16·88	27. Zn	27·51	37. Sr	36·96
		4. B	4·64	11. Al	11·56	18. —	—	28. Ga	29·49	38. Y	37·13
		5. C	5·06	12. Si	11·81	19. Ti	21·09	29. —	—	39. Zr	37·81
		6. N	5·91	13. P	13·08	20. V	21·60	30. As	31·65	40. Nb	39·66
		7. O	6·75	14. S	13·50	21. Cr	22·03	31. Se	33·50	41. Mo	40·51
1. H	0·422	8. F	8·02	15. Cl	14·98	22. Mn	23·21	32. Br	33·76	42. —	—
						23. Fe	23·63	33. —	—	43. Rh	44·05
						24. Ni	24·81	34. —	—	44. Ru	44·05
						25. Co	24·81	35. —	—	45. Pd	44·98

atomic weight of sodium being taken as 10. The atomic weights given in this Table approach pretty closely to the ordinal numbers, and if the ordinal numbers are considered as forming a straight line, the atomic weights will form a curved line, crossing and re-crossing the straight line at certain intervals, but not deviating widely therefrom. The average atomic weight in this Table is 42·31, and the average ordinal number 42·36.

All our views upon the subject of the ordinal numbers to be attached to various elements are liable to be corrected by the light of future experience. There may be elements having atomic weights as much above uranium as uranium is above hydrogen, and, on the other hand, there may be elements having atomic weights as much below hydrogen as hydrogen is below uranium. In the latter case, such an element would almost escape detection by gravimetric analysis, though it might considerably influence the character of the compounds into which it entered. But though there is no fixed limit to either the maximum or minimum atomic weight which may belong to unknown elements, such as those above alluded to, it is interesting to observe how, by simply dividing the ordinary scale of atomic weights of known elements by one and the same number, we obtain figures almost identical with the ordinal numbers.

This agreement is perhaps more evident in Table III., where the elements are arranged in sevens and tens, the atomic weights being divided by 2·37, or that of chlorine being taken as 15, nearly.

Further remarks on this subject are reserved for a future paper.

Laboratory, 9, Mincing Lane, E.C.,
May 25, 1878.

ON THE ESTIMATION OF TANNINS.*

By H. R. PROCTER.

IN view of the great diversity of results yielded by different methods of tannin estimation, and the importance for trade purposes of the adoption of some uniform standard, Kathreiner has recently published the results of a critical examination of the more important processes at present in use, with a view to selecting such as combined accuracy and constancy with sufficient simplicity for practical employment.

* Abstract of a Paper by F. Kathreiner, *Dingler's Polyt. Journ.*, No. 227, p. 481.

At the outset he notes the importance of absolute attention to details in such analyses, and instances Fehling's method of sugar estimation as one in which dependable results are only obtainable when *all* precautions are fully carried out.

He also points out a fact which is too often overlooked by analysts, viz., that there are many different tannins, and that no real percentage can be calculated till the actual tannin itself has been isolated and its coefficient determined, which, so far, has been done in but very few cases. Even if the actual percentage of the unknown tannin in some new material could be calculated, it would not necessarily settle its commercial value, which depends on the character as well as on the mere quantity of tannin, and on the presence of other matters which affect the quality of the leather, so that results of analyses can only enable us to compare the relative worth of different samples of the same material, bark with bark, sumach with sumach. For this purpose no absolute statement of percentage is needed, but if it must be given the basis of the calculation must be carefully stated.

The methods which Kathreiner selected as seeming to comply with the preliminary requirement of simplicity were five, viz., those of Carpené (-Barbieri), Hammer, Clark, and Jean.

The method of Carpené as improved by Barbieri consists in adding to the tannic solution an excess of ammoniacal solution of zinc acetate, and evaporating the mixture by the aid of heat to two-thirds of its original volume. After cooling, the precipitate is filtered out, washed with hot water, and then dissolved in weak sulphuric acid, and titrated with permanganate and indigo. The method is described in Bolley's "Handbuch der technish-chemischen Untersuchungen" (1876, part 2, p. 782), and by it Barbieri seems to have obtained constant results. Kathreiner, however, made a very large number of determinations under different conditions, using various proportions of zinc solution, and evaporating more or less rapidly. He employed both infusions of sumach and solutions of so-called *pure* tannin. He found the results wholly unreliable, the permanganate consumed varying in one set of experiments from 3·15 to 0·7 c.c. for 10 c.c. of tannin solution, according to the excess of zinc solution, and in another equally widely with quicker or slower evaporation. The highest results were obtained, in each case respectively, by employment of the smallest excess of ammoniacal solution of zinc, and by the most rapid evaporation.

Löwenthal's original method, as is well known, consists

TABLE II. (continued.)

No.		No.		No.		No.		No.		No.		No.		No.	
51. Ag	46·96	58. Cs	57·83	65. —	—	72. —	—	79. —	—	86. Au	85·65	93. —	—	100. —	—
52. Cd	48·70	59. Ba	59·57	66. —	—	73. —	—	80. —	—	87. Hg	86·96	94. —	—	101. —	—
53. In	49·30	60. Di	60·00	67. —	—	74. Er	77·39	81. —	—	88. Tl	88·52	95. —	—	102. —	—
54. Sn	51·30	61. Ce	60·87	68. —	—	75. La	78·26	82. Pt	85·83	89. Pb	90·00	96. —	—	103. Th	102·17
55. Sb	53·04	62. —	—	69. —	—	76. Ta	79·13	83. Ir	86·09	90. Bi	91·30	97. —	—	104. —	—
56. Te	55·65	63. —	—	70. —	—	77. W	80·00	84. Os	86·61	91. —	—	98. —	—	105. U	104·35
57. I	55·22	64. —	—	71. —	—	78. —	—	85. —	—	92. —	—	99. —	—	106. —	—

TABLE III. (continued.)

No.		No.		No.		No.		No.		No.		No.	
46. Ag	45.57	56. Cs	56·12	66. —	—	76. —	—	86. Au	83·12	96. —	—		
47. Cd	47·26	57. Ba	57·81	67. —	—	77. —	—	87. Hg	84·39	97. —	—		
48. In	47·85	58. Di	58·23	68. —	—	78. Er	75·11	88. Tl	85·91	98. —	—		
49. Sn	49·79	59. Ce	59·07	69. —	—	79. La	75·95	89. Pb	87·34	99. Th	·16		
50. Sb	51·48	60. —	—	70. —	—	80. Ta	76·79	90. Bi	88·61	100. —	—		
51. Te	54·01	61. —	—	71. —	—	81. W	77·64	91. —	—	101. U	101·27		
52. I	53·59	62. —	—	72. —	—	82. —	—	92. —	—	102. —	—		
53. —	—	63. —	—	73. —	—	83. Pt	83·29	93. —	—	103. —	—		
54. —	—	64. —	—	74. —	—	84. Ir	83·54	94. —	—	104. —	—		
55. —	—	65. —	—	75. —	—	85. Os	84·05	95. —	—	105. —	—		

In titrating the tannin solution with permanganate in presence of indigo and a large volume of water, the quantity of permanganate required for the complete oxidation of the indigo being separately determined and deducted from the result. The indigo not only acts as an indicator, but as a regulator of the reaction, and should be present in such quantity as to require about twice as much permanganate for its oxidation as is consumed by the tannin employed in the titration. In this case the whole of the tannin is oxidised to secondary products before the complete destruction of the indigo, while the secondary products—being more stable than the indigo—are unattacked.

This process has the merit of being simple and rapid, and also constant in its results, but in its original form these results are always too high, from the presence of gallic acid and similar bodies, which are oxidised and reckoned as tannin. This difficulty may be overcome by a second titration after absorbing the tannin with hide raspings; but this is tedious, and not easy to accomplish completely. Löwenthal has recently proposed an improvement which seems completely to meet the difficulty (*Zeitschrift für Anal. Chem.*, 1877, pp. 33 and 201). This consists in the precipitation of the tannin by gelatin solution saturated with common salt and slightly acidified. Löwenthal prepares the gelatin solution by steeping 25 grms. of the finest Cologne glue in cold water overnight, which is then melted on the water-bath, saturated with NaCl, and made up to 1 litre with saturated NaCl solution, filtered, and kept well corked: 100 c.c. of this solution is mixed with 100 c.c. of the tannin infusion, and, after stirring, 50 c.c. of water, containing 2½ grms. of sulphuric or 5 grms. of hydrochloric acid, is added. This causes the precipitate to coagulate rapidly, and after standing some hours, or overnight, a perfectly clear filtrate is obtained, in which to titrate the oxidisable matters "not tannin." (In the experience of the writer it is advantageous to reduce the gelatin to one-half the above quantity, which is amply sufficient for all suitable strengths of tannin infusion, if the acid solution also is saturated with salt.) 50 c.c. of the filtrate, equivalent to 20 c.c. of the original infusion, is usually employed for determination of the "not tannin."

The standard permanganate solution employed by Kathreiner contained 1·333 grms. permanganate per litre, and 24·1 c.c. corresponded to 0·063 grm. oxalic acid, while 20 c.c. of the solution of sulph-indigotate of potash employed required 9·5 c.c. of permanganate for its oxidation. *The strength and quantity of the tannin infusion employed must be such that in no case it requires more than two-thirds as much permanganate solution for its oxidation as the indigo*, and it is better that the latter should not require more than about 10 c.c. of the permanganate, or the darkened colour of the oxidation-products interferes with the delicacy of the end-reaction. The general method employed by Kathreiner is to add 20 c.c. of indigo solution, 10 c.c. of dilute (1 to 5) sulphuric acid, and a suitable proportion of the tannin infusion, to about 1 litre of water, and titrate with permanganate in a white porcelain basin, *very slowly*, and with constant stirring. This Kathreiner considers decidedly preferable to the usual beaker and porcelain slab, the end of the reaction being indicated by a faint rose tint round the edge of the liquid. The time allowed in titration is of great importance: not less than four minutes should be occupied with the simple tannin solution, or six in the presence of gelatine, which impedes the reaction, as Dr. Lunge has shown that viscous substances usually do. If this precaution be neglected, results considerably too high are obtained.

Employing these precautions Kathreiner obtained always constant results, and found that, even for two or three successive days, tannin solutions gave results practically identical if protected by the addition of 0·5 c.c. glacial acetic acid. He found, as the writer had previously done, that the titrations could be carried out as well by artificial as by day light without any difference in the final result, though the quantity of permanganate employed by gas-light was slightly higher. He gives it as his opinion that if the light of a petroleum lamp with opal shade were employed the end-reaction would be identical; but as any variation, so long as it is constant, has no effect on the final result, the matter is of little moment.

A point of more importance is how far the result is affected by oxidation of the gelatin, or of some oxidisable body contained in it. Kathreiner found that 50 c.c. of his gelatin solution increased the consumption of permanganate by 1·5 c.c. beyond that needed for the indigo alone. Now the 50 c.c. of filtrate usually employed in estimating the "not tannin" contains 20 c.c. of the gelatin solution, equalling 0·6 c.c. of permanganate, but in all probability part at least of the oxidisable matter is carried down by the tannin; probably, therefore, the nearest approach to truth may be obtained by deducting *half* the correction for gelatin from the oxidisable matter not tannin.

As a basis of calculation Kathreiner agrees with the writer in preferring the numbers given by Neubauer and and Oser (viz., 0·063 grm. oxalic acid = 0·04157 gallo-

tannic or 0·062355 quercitannic acids) to any attempt at comparison with so-called "pure," tannin, which often contains 20 per cent of impurities.

Kathreiner quotes Gauhe, Hewett, and myself as agreeing with him in considering Löwenthal's a rapid and easy method of analysis, and well adapted for practical use. It may be added that the method is employed by Eitner for the numerous analyses of the Vienna Government Leather Research Laboratory, and he also adopts Neubauer's and Oser's numbers for calculation.

Kathreiner's results with Clark's and Jean's methods may be very briefly stated. The first consists in precipitation of the tannin by sulphate of cinchonine, and estimation of the cinchonine by solution of mercuric chloride in potassic iodide. The end-reaction proves extremely uncertain.

Jean's method, depending on the combination of iodine with tannin and gallic acid in presence of sodic carbonate, the termination of the reaction being decided by bringing drops of the solution in contact with starch paste, was found deficient in sharpness, and the most tedious of all, owing not only to the trouble of each separate titration, but to the fact that at least six titrations in each case were necessary, viz., one approximate and two final determinations of the original infusion, and a repetition of the same after the tannin was removed by gelatin and alcohol or hide raspings. The alcohol also may lead to error, by combining with the iodine to form iodoform.

Hammer's specific gravity process is condemned not only on account of the extreme accuracy required in the areometric determinations, but because it is quite uncertain if all tannins have the same specific gravity in solution. Another and yet more formidable objection, which applies equally to the original method and to its modification by Müntz and Ramspacher, is the fact—already pointed out by the present writer—that the results are completely vitiated, not only by the glutinous matter dissolved from the raw hide employed to remove the tannin, however carefully it may have been previously washed, but by the fact that raw hide has the property of removing, and temporarily holding in combination, considerable quantities of gallic or any other acid which may happen to be present.

On the strength of these experiments Kathreiner recommends Löwenthal's improved process, with the numerical values obtained by Neubauer and Oser, for general adoption as the standard method of tannin estimation—a proposal in which the present writer heartily concurs.

The only adverse criticism noted is that of Mohr, who, however, seems to confound the Löwenthal method with that of Monier, in which no indigo was used as regulator and indicator, and the objections he makes—valid enough with regard to this—are not applicable to the later and improved method.

ON DYERS' CHEMICALS.

By J. MARZELL.

(Continued from p. 190)

II. Naphthalin.

As we have seen, naphthalin is a body easy to be got in large quantities and in a state of great purity. The most varied researches have been made to use naphthalin as a base for artificial dyes, so as to replace the more valuable benzol, but till now only small success can be noted. Though splendid dyes of nearly all shades have been produced, up to the present the mischief of an expensive production, and their not being genuine was always the weak and insurmountable point, owing to which they had to give way to the competition of even less brilliant derivatives of other hydrocarbons.

Another way of experimenting—to open up a new field for its working up—was followed up in the direction of using it as a source of other hydrocarbons by the destructive decomposition of naphthalin, and attention was especially directed to three principal points:—

(1.) Formation of lighting-gas.
(2.) Formation of benzol and homologues.
(3.) Formation of anthracen.

They are all based upon the following speculation:—Naphthalen is a product of the reciprocal reaction of the same bodies.

(1.) Representing in themselves the principal parts of lighting-gas:—

$$\underbrace{C_2H_2}_{\text{Acetylen.}} \quad \text{and} \quad \underbrace{C_2H_4}_{\text{Ethylen.}}$$

(2.) Combining themselves to benzol—

$$\underbrace{3C_2H_2}_{\text{Acetylen.}} = \underbrace{C_6H_6}_{\text{Benzol.}}$$

(3.) Forming, with the same intermediate body as belonging to naphthalin—styrol—anthracen.*

$$\text{I. } (a)\ \underbrace{C_6H_6}_{\text{Benzol.}} + \underbrace{C_2H_4}_{\text{Ethylen.}} = \underbrace{C_8H_8}_{\text{Styrol.}} + 2H.$$

$$\underbrace{C_8H_8}_{\text{Styrol.}} + \underbrace{C_2H_4}_{\text{Ethylen.}} = \underbrace{C_{10}H_8}_{\text{Naphthalin.}} + 2H.$$

$$\text{I. } (b)\ \underbrace{C_8H_8}_{\text{Styrol.}} + \underbrace{C_6H_6}_{\text{Benzol.}}\dagger = \underbrace{C_{14}H_{10}}_{\text{Anthracen.}} + 4H.$$

$$(a)\ \underbrace{C_6H_6}_{\text{Benzol.}} + \underbrace{2C_2H_4}_{\text{Ethylen.}}\ddagger = \underbrace{C_{10}H_8}_{\text{Naphthalin.}} + 2H.$$

$$(b)\ \underbrace{2C_6H_6}_{\text{Benzol.}} + \underbrace{C_2H_4}_{\text{Ethylen.}} = \underbrace{C_{14}H_{10}}_{\text{Anthracen.}} + 6H.$$

To decompose naphthalin the same way was followed which led to its formation—dry distillation, effected by the leading of naphthalin vapours through red-hot iron pipes. The results, however, did not turn out satisfactory.

I. *Use for Lighting-Gas.*

Already, in 1867, John Hamilton took a patent in this direction. The proportions he is stating are 1 ton of powdered coal mixed with 480 k. creosote oils and 2½ k. naphthalin. The whole is submitted to distillation. The yield is said to be 420 c.m. of a very good gas. Following other statements it is 600 to 800 c.b. per 1 c.m. of the mixture.

Another idea was to dilute naphthalin in petroleum or crude coal-tar oils, let the fluid be sucked up by porous bodies (turf, wood, &c.), and submit the whole to a distillation in a retort.‖ About the results there is nothing published.

If the vapours of naphthalin, so rich in carbon, could be added to lighting-gas a higher illuminating power of the latter could be expected. But researches show naphthalin to have such a very small power of evaporation that no speculation could possibly be based upon it. At common temperature, exposed to the air, only 6¼ per cent of the naphthalin evaporated away in nine days.

About the conversion into gas itself the results were no better. The apparatus used consists of an iron pipe, being filled with pieces of bricks to multiply the surface, being kept red-hot. The naphthalin vapours passed through slowly did not yield any permanent gases, the naphthalin condensing undecomposed in the receiver.

Exposing naphthalin vapours to heat, together with hydrogen gas, to effect assimilation, and gathering the gas

* Berthelot, "Chimie Fondée sur la Synthese," i., p. 34, 50.
† G. Auerbach, "On Anthracen;" London, 1877, p. 15.
‡ Berthelot, *Zeit. f. Analyt. Chemie*, 1869, 37.
‖ Martin, *Journ. f. Gasbeleuchtg.*, 1868, ix., p. 250.

escaping out of the condenser over water, did not give any results. After cooling, the gas was allowed to issue from a fine jet, but the blue flame proved that the hydrogen gas was not saturated with any hydrocarbons, as was expected.

In looking at the parallel researches with the heavy petroleum oils, it is strange that by this same method such good results could be obtained, utilised practically in the so-called Lowe's process,* which seems to answer all expectations. It consists in principle in mixing the vapours of very heavy paraffin oils with hydrogen—got by passing water over anthracite coal at a white heat.† The yield is said to be of the best quality, and combining with its other good points the advantage of being 35 per cent cheaper than the ordinary light-gas.

Other researches of Wagner, to pass the naphthalin vapours through red-hot pipes together with paraffin oils, did not turn out better results than the former experiments, and comparing this with Hamilton's patent we must come to the conclusion that in them coal plays a principal *rôle*.

Phillips, Besling, and Kohlstadt‡ have tried to use naphthalin for illuminating by burning it together with other hydrocarbons in oxygen. The patent prescribes a mixture of $40C_{10}H_8$ and 60 mineral oils, and special lamps have been made for that purpose.

II. *Working Up for Benzol Homologues.*

Here also the researches did not end satisfactorily. On passing the naphthalin through heated pipes by itself and with steam did not give any results. Though with the intermediate phases "phthalic acid and benzoic acid" the formation of benzol does not offer many difficulties, that process, on account of its complication, will never have any practical interest unless the speculation was realised by a direct and cheap oxidation process (perhaps by having naphthalin vapours over heated peroxides of manganese, lead, barium, &c., to convert the naphthalin directly into benzoic acid, from which benzol could be got without great loss by distillation with lime.

J. Rowley|| follows up another way for the same purpose. He saturates naphthalin with chlorine gas, and then submits the resulting mixture of chlorine compounds and free naphthalin to distillation. At first oil passes over, and afterwards a fatty matter can be gathered. This mass is added, from 10 to 25 per cent, to a naphtha highly purified by H_2SO_4 beforehand. In distilling, benzol and its homologues are got, from which aniline dyes can be made. Instead of distillation, the fatty matter can be separated from the liquid part by pressing or filtering, but the first way is to be preferred. The results of this method are not published. In saturating with chlorine gas a mixture of chlorine derivatives of the naphthalin addition- and substitution-products and of unattacked naphthalin are formed. We shall return or refer to the former again when speaking of phthalic acid.

III. *Working Up for Anthracen.*

It is curious that the patent out on this subject by J. Barrow§ follows the same way, having shown no results whatever in the above-mentioned identical process—the decomposition by heat. According to the patent—"Naphthalin vapours, or hydrocarbons containing naphthalin, are passed through retorts heated sufficiently to decompose the naphthalin. The obtained anthracen is purified by distillation, crystallisation, and sublimation." As there are no results published about this, the importance of the matter induces me to make some researches of the same. The iron pipe was about 1½ inches, and was heated to a clear red-heat in a combustion-furnace (with the principal part of the experiments the furnace was heated with charcoal). The tube was either left empty or filled with charcoal, and—it may have been only an accident—in the latter case I observed that the decomposition proceeded easier. The naphthalin vapours were always passed through very slowly. The resulting product consisted mostly of undecomposed naphthalin, but a small quantity of fluid and a green sublimate could always be identified. To test the anthracen the product was pressed and dried, and then submitted to an oxidation with chromic acid and glacial acetic acid, the resulting anthraquinon being calculated back to anthracen. By the violent oxidation naphthalin was destroyed, being converted into phthalic acid, which was washed out with water. As I could not finish my researches definitely, I cannot give numbers as to the yield, but will only remark that the result was in most cases between 0·1 and 0·2 per cent of the naphthalin really passed through the tubes. I hope to be able to conclude the researches soon, and shall not fail to communicate the results as addition to the above.

Comparing the contradictory results of the different searchers, it is easy to see that a wide field is here still open both to practical speculation and theoretical work. A body got in such, we may say, unlimited quantities, and in such a state of purity by the most simple means of purifying, offers too many advantages as crude material for it to be thrown away as useless before the most exhausting researches have been made.

It has been recommended to use the naphthalin in agriculture against the attacks of insects. It does not kill them, only drives them away by its smell. Its small evaporating power, combined with a comparatively strong odour, makes it fit for this purpose.

(To be continued)

* L. Ramdohr, *Dingler's Journal*, ccxxii., p. 153.
† *Wagner's Jahresberichte*, 1875, p. 1118.
‡ A.D. 1869, No. 1911.
|| Patent 2222, A.D. 1869.
§ A.D. 1870, No. 1120.

NOTICES OF BOOKS.

Ure's Dictionary of Arts, Manufactures, and Mines. By ROBERT HUNT, F.R.S. Vol. iv., Supplement. London: Longmans and Co., 1878.

THE last edition of Ure's Dictionary was published in 1875, and the appearance of a supplement, bringing our information down to the beginning of the present year, will be hailed with satisfaction both by the manufacturer and the technological student. The arts and manufactures are now-a-days making such perpetual progress that it is almost impossible to keep pace with them, even with so watchful and laborious an editor and staff as the Keeper of the Mining Records and his able assistants. A great deal may, however, be effected by the frequent publication of supplementary volumes instead of waiting until a new edition of the work is necessary. This has been done in the present case and in that of the sister work, "Watts's Dictionary of Chemistry," and we do not see why such supplements should not be issued even yearly, the whole being collected into a new edition at the end of every seven years.

While the present work was passing through the press an instance occurred which shows the conscientious way in which the editor has endeavoured to keep abreast of the times; but in spite of his most strenuous efforts, he was of necessity obliged to give in just at the end of the race. While the last sheets of the work were being corrected certain improvements were made in the phonograph and the electric light, and MM. Cailletet and Pictet announced their grand discoveries. These important items were too late to appear in their proper places; an account of them was therefore added as an addendum at the end of the book, but hardly had Mr. Hunt sat down to rest himself after his arduous task than the microphone and its wonders burst upon the world, too late, of course, to receive any notice at all.

On testing the work in numerous places we find that the information given is most complete, and is brought down to the latest possible date, as may be easily guessed

when we state that we have full details of the telephone, the phonograph, MM. Cailletet and Pictet's methods of solidifying and liquefying oxygen, hydrogen, and nitrogen, the Jablochkoff electric candle, and the latest improvements in electric illumination; the newest processes in the direct conversion of iron into steel by the Bessemer and Siemens's methods, the coal-tar dyes, and a large number of other discoveries, the present volume being the first manual of the kind in which they are described.

Taking a few headings almost at random we find under artillery an excellent account of the 81-ton gun; under diamonds we have a long and interesting description of the discoveries at the Cape of Good Hope. Artificial alizarin and its congeners, and the numerous compounds of a tinctorial nature lately obtained from anthracen and naphthalin, are well described. As might have been expected Mr. Hunt has taken particular pains with the articles connected with his own special subject, such as mining and metallurgy, the whole of which are of the greatest interest and value. The account given of the different forms of rock-boring machinery is most exhaustive, and is illustrated by nearly forty cuts and diagrams. The completeness of these articles, it must be understood, in no way interferes with the fulness of the information given on other subjects. Another excellent article on the industrial applications of the spectroscope very fully describes the experiments made by Professor Roscoe and Dr. Marshall Watts in connection with the Bessemer process, as well as those made by Sir J. G. W. Alleyne for the detection of small quantities of phosphorus in iron and steel. The tentative enquiry made by Messrs. Norman Lockyer and Chandler Roberts into the possibility of applying the spectroscope to the quantitative analysis of gold alloys is also well described. The article on explosives is particularly complete, a short account of Nobel's very latest invention—blasting gelatin—appearing amongst the addenda at the end of the book.

A large proportion of the articles are written by the discoverers and inventors themselves, either expressly for the work or for some English or foreign technological journal. This method of obtaining information no doubt insures its correctness, but inventors and discoverers are only mortal after all, and are sometimes open to the charge of concealing, or at any rate extenuating, the defects of their offspring. Some of the extracts would have borne condensation without much harm. Jocular and gossipping letters from the *Times* on the preservation of lime-juice, or the spontaneous fracture of a toughened glass gas globe in a lady's bedroom, are hardly fit for insertion in a serious work such as the present, without some kind of editorial excision or manipulation.

Mr. Hunt has been assisted in his labours by a goodly host of fellow workers, both British and foreign, who seem to have joined in the task with as much industry and good will as their veteran leader.

Mr. Hunt sets an excellent example to the editors and compilers of similar works who are only too fond of taking their information from every possible source without ever thinking of mentioning their indebtedness to the original author or periodical whose stores they have ransacked; Mr. Hunt, on the contrary, in nearly every instance, cheerfully acknowledges the source whence he obtains his knowledge. Another good point in the book is the frequency with which the editor gives us bibliographical references to original papers and researches, when, from considerations of space and interest, he has been obliged to shorten a description or omit details. The cross references are numerous and add much to the handiness of the book.

It would be folly to expect absolute perfection in a work of the kind, but the proof sheets in a few instances appear to have been read by some one who is but little acquainted with the names of scientific men. Although they do not in any way interfere with the real value of the book, such substitution compounds as Raoul Pictet, Sergius *Herne*, Arnandon, Allan Miller, and Neil (for Feil), must be regarded as blemishes which a little care might have eliminated. The volume numbers over 1000 pages, and is well and clearly printed.

We must congratulate Mr. Hunt and his assistants on the success which has attended their endeavours to present the scientific reader with the latest information regarding processes and manufactures of every description.

"Watts's Dictionary of Chemistry" and the present work are the natural complements of each other, and with their supplements form in themselves a scientific pair, which are absolute desiderata to all technological workers and institutions.

Ninth Annual Report of the State Board of Health of Massachusetts. January, 1878. Boston: Rand, Avery, and Co.

PERHAPS the most generally interesting article in this issue is a paper by Dr. Joy Jeffries on the "Dangers arising from Colour-Blindness." The author explains very clearly the nature of this defect, concerning which very vague notions are still entertained even by educated persons. He points out that colour-blindness by no means involves any inability to distinguish forms. To the colour-blind all mixed tints, in proportion as they contain his faulty colour, will appear so much the darker. Where we see colour he simply sees, so to speak, its absence, an object of his faulty colour appearing to him as grey does to the normal eye. A red-blind person cannot distinguish that colour from its complementary, green. Now it might seem, at first glance, that a defect of this nature would be very easily detected. Such, however, is not the case. As Dr. Stilling remarks—"It is a well known fact that colour-blind persons, by exercising their faculty of judgment, can aid their want of sensibility, and are able to conceal their defect to a certain extent. They have learned the names of colours quite as well as normal-sighted people, and by the help of every outward sign they have acquired a certain knowledge of those pigments to the characteristic tints of which they are blind." To take an example:—A man who is red-green colour-blind will have learned, like his neighbours, that grass is green. If a blade of grass is placed before him he will recognise it by its form, and if asked its colour he will give a correct reply. If, again, we ask him the colour of a rose he will tell us, on the same principle, that it is red. There are, indeed, white roses, but these he will distinguish from the red varieties by the deeper colour of the latter, which to him will seem of different shades of grey. Hence, in order to test a supposed colour-blind person, it is necessary, not to ask him to name the colours of familiar objects, but to set him to "match off" a number of bits of cloth, or skeins of silk, or woollen yarn. If we give him, say, half a dozen shades of red and as many of green, and find that he places these respectively in two distinct groups, we may pronounce him free from the red-green form of colour-blindness. These principles the author applies to the subject which he is practically considering, viz., colour-blindness in railway officials, steersmen, military and naval officers, &c. In certain departments of manufactures and commerce this defect in vision is a fatal disqualification to the individual, but it does not constitute a source of public danger. Not so in the spheres of activity above mentioned. All vessels are now required to display from sunset to sunrise a green light on the starboard, and a red light on the port side. These lights indicate not merely the position of the vessel but the direction in which she is moving. If, however, the steersman, or the look-out, or the officer of the watch is unable to distinguish red from green this precaution is entirely useless. The exact position of a ship on nearing the coast is often known to the captain merely by the different colours of light emitted by lighthouses. But if colour-blind he confuses these indications. Hence this defect of the sight must be considered an absolute disqualification for

an officer, either in the navy or the mercantile service, and all candidates for such posts should be systematically examined in the very outset. Very similar is the case with the officials of railways. An engine-driver to whom a red flag by day or a red lamp by night appears merely like a dusky white is obviously unfit for his duties.

The question has been asked whether form might not be substituted for colour as a sign of danger whether by land or sea. By day this is of course possible, but all attempts to do away with coloured lamps as signals by night only lead to greater complication and multiply the sources of error.

The prevalence of colour-blindness is far wider than has been supposed. The results obtained by different investigators in different countries, and perhaps in some cases using imperfect tests, offer wide discrepancies. Still it would seem that, on the average, 5 per cent of the population are in a greater or less degree affected with this peculiarity. Nor is it, as was once supposed, confined to the male sex. The disease is mostly congenital and often hereditary, but it is capable of being brought on by accidents and by drunkenness.

Report on the Progress of the Iron and Steel Industries in Foreign Countries. Vol. ii. 1877. By JULIEN DEBY, C.E., Foreign Secretary to the Iron and Steel Institute. Newcastle-upon-Tyne: M. and M. W. Lambert.

THIS volume gives the technology and statistics of the iron manufacture abroad, especially in America, Belgium, France, and Germany. The various procedures for the analysis of irons, iron-ores, and intermediate products here described are for the most part already known to our readers. Reference is made to a paper by M. A. Martens, who considers it practicable to determine the quality of certain varieties of iron and steel by the use of the microscope. The editor remarks, however, that M. Martens appears to have overlooked the researches of Mr. Sorby in the same direction.

The direct production of malleable iron and steel from the ore, with the ultimate suppression of the blast-furnace, is still held up as a great unsolved problem. Especial notice is made of the process of Du Puy, who, judging from the trial already made, appears to eliminate three-fourths of the phosphorus present in the ore. The inventor's theory is that as phosphorus is easily fusible, and as the non-metallic elements if combined with proper fluxes also melt at a much lower heat than the metal, the phosphorus becomes incorporated with the glassy slag of the former, and never leaves it.

Mr. C. Ryder suggests the possibility of testing the degree of carbonisation in steel by a process based on the fact that the permanent magnetism of steel is affected by the percentage of carbon it contains. He exposes the steel to a strong current, and measures the effects. He also exposes, at the same time, a piece of standard steel of known carbonisation to the same influence. He considers that by this method a better knowledge can be obtained of the properties of the steel and the uses for which it is adapted than by chemical analysis alone.

Whilst fully admitting the great value of this Report to all persons connected with the metallurgy of iron, we cannot help pointing out that its utility would be much increased by a good index, especially as the table of contents, placed where it may possibly be overlooked altogether, extends only to twenty-four lines. This deficiency makes reference to any particular passage almost impossible.

Bulletin of the Bussey Institution. Vol. ii., Part 3. 1878. Boston: John Allyn.

THIS issue contains an interesting paper on the hybridisation of lilies, the conclusion being that the principal species of the genus when hybridised produce offspring which show the features of the male parent very slightly, or only in exceptional cases. Such cases are, however, so remarkable at times that their rarity ought not to discourage the experimentalist.

Prof. Storer has made an elaborate examination of the shells of crabs and lobsters, in comparison with those of oysters, clams, and other mollusks, with a view to the determination of their manurial value. In none of the latter class does the proportion either of potash, phosphoric acid, or nitrogen reach even 0·1 per cent. The shells of the crustaceans, on the other hand, contain notable quantities of these valuable constituents, amounting to 3·5 per cent phosphoric acid in the lobster, and 12·7 per cent nitrogen in the king-crab.

The same able and indefatigable chemist furnishes a paper on the prominence of carbonate of lime as a constituent of solutions obtained by the percolation of water through dry cultivable soils.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

MAY, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in a 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Anhydride. Sulphuric	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Clear	0·000	0·009	0·120	0·066	19·40	8·170	0·360	1·01	1·600	13·2	2·80
West Middlesex	Clear	0·000	0·010	0·120	0·084	19·20	7·840	0·360	1·01	1·530	13·2	3·30
Southwark and Vauxhall	Clear	0·000	0·009	0·135	0·077	19·00	7·890	0·320	1·01	1·530	13·2	3·30
Chelsea	Clear	0·000	0·007	0·135	0·056	18·40	7·750	0·390	1·01	1·560	12·6	3·70
Lambeth	Clear	0·000	0·008	0·156	0·063	20·60	8·400	0·430	0·94	1·630	13·7	2·80
Other Companies.												
Kent	Clear	0·000	0·001	0·450	0·001	32·00	12·260	1·150	1·73	4·860	20·6	7·50
New River	Clear	0·000	0·005	0·144	0·024	17·60	7·950	0·280	1·01	1 000	12·6	3·70
East London	Clear	0·000	0·007	0·135	0·049	18·10	6·380	0·360	1·15	1·600	12·1	3·30

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 19, May 13, 1878.

Researches on the Law of Avogadro and of Ampère.—M. A. Wurtz.—The author infers from his experiments that dry oxalate of potassium becomes hydrated in the same manner in an atmosphere of chloral hydrate, and in an atmosphere of moist air, or chloroform containing watery vapour at the same tension as the atmosphere of chloral hydrate. Hence he concludes that the latter is entirely dissociated, for the watery vapour which it contains is absorbed sensibly in the same manner as the vapour of water freely contained in an artificial atmosphere at the same tension.

Polymerisation of Ethylen Oxide.—M. A. Wurtz.—If to oxide of ethylen a fragment of melted chloride of zinc be added, the whole becomes solid in the course of some months.

The Microphone of Mr. Hughes.—M. du Moncel.

Refraction of Organic Bodies considered in the Gaseous State.—M. Mascart.—The refraction of a gaseous mixture is equal to the sum of the refractions of the constituent gases, each of them being reduced to the total volume of the mixture, but this law is inexact for compound bodies, the real refraction of which is generally less than what the calculation would indicate. Four substances alone seem exceptional, the protoxide and binoxide of nitrogen, hyponitric acid and ammonia. The three former are endothermic, that is to say they cannot be obtained without absorption of heat, whilst ammonia is formed with liberation of heat. The cause of this increase of refraction, therefore, does not seem to depend on the sign of the thermic phenomena accompanying combination. Further hydriodic acid is also endothermic, yet the refraction of the gas follows the general rule. It appears that no method founded upon the sole consideration of elementary composition permits us to calculate the refraction of a compound from that of its elements.

Production of Sulphuretted Oils Possessing Insecticide Properties.—MM. de la Loyère and Muntz.—The oils in question are obtained by the distillation of the bituminous limestone of Orbagnoux, near Seyssel. They have been successfully used against the phylloxera.

The Telephone.—M. Izarn.—The author having set up a telephone, the wire of which is connected with two gas-burners, finds that it transmits very distinctly the signals traversing two telegraphic systems, not merely absolutely distinct from his wire, but at a considerable distance.

New Electric Incandescence Lamp, acting in the Open Air.—M. Em. Reynier.—The new electric lamp depends on the following principle: if a slender rod of carbon, pressed laterally by an elastic contact, and impelled axially against a fixed point of contact, is traversed between these two contacts by a sufficiently energetic current, it becomes incandescent in this portion, and burns tapering away towards the end. In proportion as the consumption of the end proceeds, the rod being continually propelled moves forward, so as still to abut against the fixed contact. The heat developed by the passage of the current is greatly increased by the combustion of the carbon. The model submitted to the Academy gave a clear white light with four Bunsen elements. With more powerful electric sources many lamps may thus be worked.

Reproduction of Quartz by the Dry Way.—M. P. Hautefeuille.—At the temperature necessary to maintain the tungstate of soda in fusion, about 750°, grains of amorphous silica disappear, and are succeeded by agglomerations of transparent rods, and if the heat is continued for several hundred hours, double hexagonal pyramids appear, having all the characters of the quartz.

Production of Heat by a Chemical Action.—T. L. Phipson.—If a fragment of calcic hypochlorite is held before the orifice of a tube from which issues a rapid current of sulphuretted hydrogen, the following phenomena are remarked:—All odour of sulphuretted hydrogen disappears immediately, and is succeeded by a strong smell of chlorine. A slight deposit of sulphur is formed upon the solid fragment, and the disengagement of heat is so rapid and intense that the hypochlorite can scarcely be supported in the fingers. The sulphhydric acid displaces, therefore, the hypochlorous acid, liberating chlorine as do the other hydracids; that is to say the hydrogen of these acids is burnt by the oxygen of the hypochlorous acid, the chlorine of the latter becoming free. In the present case the hydrogen is burnt so rapidly that a slight deposit of sulphur is formed upon the hypochlorite, but the bulk of the sulphur is burned to sulphuric acid at the same time as the hydrogen.

Action of Watery Vapour upon the Hydrocarbides raised to a Red Heat.—M. Coquillion.—The author has previously pointed out the increase of volume produced on passing hydrocarbides over palladium wire, heated to redness along with a proportion of oxygen insufficient for their combustion. He has now examined under what conditions and to what extent this augmentation of volume is produced. These reactions throw a light upon the part played by hydrocarbides in blast-furnaces, and show the influence of watery vapour, which facilitates their dissociation, producing at the same time a fall of temperature, which is added to that due to the transformation of carbonic acid into carbonic oxide.

Distribution of Salts in the Soil.—M. H. Pellet.—A large proportion of salts have a tendency to climb; those which descend are chiefly of a deliquescent nature, such as carbonate of potassa, and chloride of calcium; nitrate of lime, however, has a remarkable climbing tendency. The nature of the soil (coarseness or fineness of its particles, proportion of moisture, &c.), influences the ascent of salts. In one and the same soil, a part of the salts may be carried downwards by moisture, and if evaporation from the surface is resumed, may anew begin to ascend. The extreme layers of the permeable soil will always be found richest in fertilising matter, whilst the intermediate portion is impoverished. Superphosphate of lime is remarkable for its climbing powers.

Detection of Ozone in the Air.—M. G. Daremberg.—The author finds that in his observations, ozonoscopic papers were little affected at the coast line, whilst at the distance of 30 metres, the impression was much stronger. The action increases with the wind.

Justus Liebig's Annalen der Chemie. Heft 1 and 2, May 9, 1878.

The Amidines and the Monobasic Organic Acids of the Thiamides.—August Bernthsen.—In this paper the author examines at great length the amidines of monobasic organic acids, the relations between the thiamides and the amidines, and the thiamides of the monobasic organic acids. He considers it as established that the amidines of these acids behave with sulphuretted hydrogen exactly as on partial saponification by means of water. Carbon bisulphide behaves also differently with amidines than with the primary amines of the univalent alcohols: the imid-residue (NH)″ or (NR)″ is substituted for the univalent sulphur.

Communications from the University Laboratory of Prague, sent in by E. Linnemann.—These include a paper by E. Linnemann on the behaviour of propyl-glycol

on being raised to an elevated temperature in presence of water, the result being the formation of propyl-aldehyd as a product of decomposition. An essay by B. Brauner on the "Direct Conversion of Isobutyl-iodide into Trimethyl-carbinolamin;" a treatise on "Artificial Malic Acid, prepared from Fumaric Acid," by F. Loydl; a paper by Dr. O. Völker, on "Maxwell-Simpson's Synthesis of Acrolein," and one by V. v. Zotta, on "Behaviour of β-Dibrom-propionic Acid with Potassium Iodide."

Communication from the Laboratory of the University of Würzburg.—These communications comprise the following papers:—"On Vinyl-ethyl Ether," by J. Wislicenus; "Synthesis of Glutaric Acid, and α-Methyl-glutaric Acid by means of Acetic-ester," by J. Wislicenus and L. Limpach; "Synthesis of Pyrotartaric Acid by means of α-Methyl-acet-succinic-ester," by G. Kressner; "On α-β-Dimethyl-acet-succinic-ester and Symmetrical Dimethyl-succinic Acid," by Fr. Hardmuth; "On α-Ethyl-acet-succinic-ester, and Ethyl-succinic Acid," by Carl Huggenberg; "Improved Method of Preparing Single and Double Organic Substituted Acetic-esters," by Max Conrad and L. Limpach.

Optical Rotatory Power of Liquids and Dissolved Substances.—O. Hesse.—If a solvent exerts an influence upon an optically active body, the rotatory power in question furnishes a standard for the work effected by the power of permanence of the active substance, and by the intensity with which the inactive particles react upon the active ones. It must be assumed that one series of solvents will behave alike with respect to an active body dissolved and inversely, but that others will behave differently, so that one and the same body may have several limited rotatory powers. The temperature also may have an influence. Thus certain kinds of sugar may have several limited rotatory powers for one solvent. In order to determine the limited rotatory power of a substance, it is, therefore, necessary to particularise the quality of the solvent and the method of solution.

On Glucose.—O. Hesse.—The author finds that the melting-point of glucose, though not strictly constant, lies between 80° and 84°.

On Phlorose.—O. Hesse.—The author applies this name to the sugar formed according to the process of H. Schiff, by the decomposition of phlorizin with sulphuric acid. Its composition is shown by the formula $C_6H_{14}O_7$. Its melting-point is 74°, and its rotatory power $\frac{1}{4}$ that of glucose.

On Phytosterin and Cholesterin.—O. Hesse.—Phytosterin, a product obtained from the calabar bean, agrees in composition with cholesterin, *i.e.*, $C_{26}H_{44}O$, but it occasions a smaller deviation of the plane of polarisation.

Remarks on Amyrin and Icacin.—O. Hesse.—The author assigns to amyrin the formula $C_{47}H_{75}(OH)_2$, and to icacin $C_{47}H_{77}OH$.

On Cynanchol.—O. Hesse.—The author compares the properties of cynanchocerin, cynanchin, echicerin, and echitin, and considers that the distinguishing characteristics of these four bodies must be sought in their crystalline forms and melting-points.

Composition of the Alkaloids of Sabadilla Seed.—O. Hesse.—An examination of the composition of sabadillin, sabatrin, and veratin.

A Contribution to a Knowledge of the Alkaloid named Quinidin by Henry and de Lombre.—O. Hesse.—The author considers Delondre's quinidin as identical with the quinidin of Winckler.

On Euphorbon.—O. Hesse.—The author assigns to this substance the composition $C_{15}H_{24}O$. Its melting-point is from 113° to 114°.

Constitution of the Benzol-derivatives.—E. Wroblevsky.—A hypothetical paper which does not admit of useful abstraction.

Production of Cymol from Cuminic Alcohol.—K. Kraut.—The author admits that cymol cannot be produced from cuminic alcohol by the action of alcoholic potassa. He has obtained it, however, by submitting cuminic alcohol to prolonged ebullition with zinc-powder.

Researches Conducted in the Laboratory of Prof. F. Beilstein, at St. Petersburg.—These communications comprise the following papers:—"On the Chlorine Derivatives of Benzol," by F. Beilstein and Ap. Kurbatow; "On the Preparation of Glycol," by St. Stempnewsky; and "On the Behaviour of Chloroformic Ether with Potassium Cyanate," by Dr. Th. Wilm.

Preparation of Ethylen, and on Certain Ethen Compounds.—Emil Erlenmeyer.—The author combats the objections raised by Demole against his method of preparing ethylen, and approves of Atkinson's process for obtaining monacetin and glycol.

Gazzetta Chimica Italiana.
Fasc. ii. and iii., 1878.

Preliminary Note on Hippurate of Amyl, and Notice on Hippuric Acid.—G. Campani.—Hippurate of amyl crystallises in very minute prisms of a slightly yellowish colour, and of a faint fruity odour, heavier than water, in which they are scarcely soluble, but dissolve very readily in alcohol and ordinary ether. The melting-point is +27—28°. Amyl-hippuric ether on boiling in aqueous potash readily reproduces hippuric acid and amylic alcohol. The results of its analysis agree with the formula $C_{14}H_{13}NO_3$. The author gives 188·5° as the melting-point of hippuric acid.

Electrolytic Researches on Certain Glucosides.—Michele Coppola.—The author has investigated the electric decomposition of salicin and amygdalin. The results show that amygdalin, like salicin, is resolved by electrolysis, as by the action of dilute acids and organic ferments, into glucose, benzoïc aldehyd, and hydrocyanic acid.

Mother-Liquor of the Saline Springs of Volterra.—Dr. A. Fumaro.—The chief point to be noted is, that the water at sp. gr. 1·215 contains 21·616 grms. potash per litre.

On Nitroso-furfurin and Oxynitroso-furfurin.—R. Schiff.—Nitroso-furfurin, $C_{15}H_{11}N_3O_4$, is insoluble in water, tolerably soluble in alcohol and ether, from which it separates in large triclinar gold-coloured crystals. To oxynitroso-furfurin he gives the composition $C_{15}H_{11}N_3O_7$.

On a Reagent for Reducing Substances in General, and in particular for Glucose.—Egidio Pollacci.—The base of the reagent in question is hydrated ferric oxide, prepared and applied as follows:—Introduce into a flask 2 to 3 c.c. of distilled water, into which is put, by means of the end of a small glass rod, about half a drop of an aqueous solution of pure ferric chloride, and then three or four drops of caustic soda dissolved in distilled water, and finally is added the substance to be examined. This being done the mixture is shaken, heated to a boil for a minute or two, and then, after having withdrawn it from the fire, a drop of concentrated sulphuric acid is added. This having been done, the tube is cooled, by letting water fall upon it, and when the liquid is sufficiently cool, the tip of a small glass rod is introduced with half a drop of a freshly prepared solution of pure ferridcyanide of potassium (red prussiate). If the addition of the ferridcyanide does not give rise at once to the production of Prussian blue, the suspected substance contains no reducing agent. A blue colouration more or less heavy indicates, on the other hand, the presence of a reductive substance.

Certain Decompositions of Strychnine.—R. Schiff.—Strychnine introduced into nitric acid dissolves with the evolution of heat and the production of abundance of nitrous vapours. On diluting the solution with water,

there is formed a yellow amorphous precipitate, a mixture of a base and of a neutral body. To separate these two compounds, they are dissolved in glacial acetic acid, and precipitated with water. The neutral substance is thrown down as a yellow amorphous powder, whilst the base remains in solution, and may be precipitated with sodium carbonate. This latter product appears to be nitro-strychnine. If the solution of strychnine in concentrated nitric acid is heated for some hours on the sand-bath, and allowed to cool, a yellow crystalline substance is deposited, the quantity of which is considerably increased on adding water to the liquid. This compound is an acid of the composition $C_{16}H_{11}N_4O_{15}$.

Action of Hydriodic Acid upon Olivile.—D. Amato.—The author has obtained several products the nature and properties of which are not yet determined.

On Certain Reagents for Glucose.—Dr. G. Mazzara.—The author mentions nickel sesquichloride as a very sensitive reagent, its reduction to protoxide being marked by the change of colour. He places a little of the sesquioxide in a test-tube, adds a little of a solution of potassic hydrate, and on heating along with the smallest quantity of glucose the sesquioxide is at once converted into a green powder. This reduction, however, like that of ferric oxide, takes place in presence of many organic bodies.

Formation of Digallic Acid, and on the Nature of Tannin.—H. Schiff.—A polemical paper of little general interest.

On β-Chlorobutyric Acid and some of its Derivatives.—Luigi Balbiano.—The author examines the chlorobutyrate of ethyl and oxybutyric acid, pointing out the characteristic reactions of the normal acid, of the α and β varieties, and of that obtained from chlorobutyric ether.

Action of Anhydrous Sulphurous Acid upon Alcohols.—Stefano Pagliani.—The acid having been treated along with ethylic alcohol to 180° in a sealed tube, the liquid, on the addition of water, deposited a white sediment of sulphur. On saturation with baryta, and distillation, a liquid was obtained having the odours of ether and mercaptan. The filtrate contained not a trace of a barytic salt. On prolonged action at a higher temperature, the products formed were sulphur, ether, sulphydrate of ethyl, and ethylo-sulphuric acid.

Guaiacum-Resin considered as a Reagent for the Salts of Copper.—Enrico Purgotti.—Schœnbein pointed out that the compounds of copper in presence of hydrocyanic acid or of cyanides produce indirectly the reactions of ozone, and in particular that of giving a blue colour with tincture of guaiacum. The author finds that beside the cyanides, ferro-cyanides, nitro-prussiates, sulphocyanides, the alkaline and alkaline-earthy chlorides produce the same effect.

Fatty Matter of Vateria Indica.—Prof. Giovanni Dal Sie.—A lengthy paper, not suitable for abstraction.

Calamine Rich in Indium.—A. and G. De Negri.—The calamine in question is that from the mine of Oneta, in the province of Bergamo.

Analysis of the Iodo-bromic Mineral Water of Casteggio.—A. and G. De Negri.—An exceedingly complex water, containing in addition to the more common constituents, lithium, rubidium, cæsium, cobalt, bismuth, and zinc.

Temperature of Flames.—F. Rossetti.

Determination of the Proteinic Matter in Forage.—Fausto Sestini.

On Liquorice Root.—Fausto Sestini.—None of these papers are capable of useful abstraction.

Reimann's Färber Zeitung,
No. 19, 1878.

This issue contains the conclusion of the paper on "malachite-green." It is remarked that this colour is distinguished from methyl green by its greater power of resisting soap, acids, and high temperatures; that it can be applied upon wool in a slightly acid bath, and can, therefore, be used along with picric acid, and other dyes of a similar nature. The wool does not require any preparatory mordant, but a little hyposulphite of soda and mineral acid are added along with the dye.

The rest of the issue is chiefly taken up with an account of Kallab's patent process for bleaching wool with the hydrosulphite of soda.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 3, May 16, 1878.

M. Navez criticises the assertion ascribed to M. du Moncel, that the audible vibrations of the telephone are produced by the metallic nucleus of the instrument even without the vibrating plates. If like M. du Moncel, Mr. Spottiswoode has found these plates useless, it is because in the execution of his experiments he placed himself in circumstances proper for the propagation of sound by intermolecular vibrations. M. du Moncel claims the invention of the telephone for M. C. Bourseulles, sub-inspector of telegraphic lines at Auch. The idea of causing plates to vibrate at a distance entitles M. Bourseulles to rank among the precursors of Bell and Edison, but nothing further.

M. Maiche suppresses the metallic sound of the human voice as transmitted by the telephone by stretching before the magnetised bar a film of caoutchouc of 4 centimetres at most in diameter by 1 millimetre in thickness, upon the centre of which he cements a disc of tinned iron of the same thickness and of 3 centimetres in diameter.

Moniteur Scientifique Quesneville.
May, 1878.

On Cadaveric Alkaloids, and on their Importance in Toxicology.—Prof. F. Selmi.—In the course of toxicological experiments the author has discovered, in extracts obtained from the bodies of persons who had died naturally, several substances possessing the general characters of the alkaloids, and has found that they are derived from the spontaneous decomposition of the cadaveric matter. Some of them are fixed, and others volatile; some are soluble in ether; others insoluble in that medium, but soluble in amylic alcohol; and others, again, insoluble in both these liquids. Generally the fixed cavaderic alkaloids yield a precipitate with almost all general reagents. Some of them are precipitated by platinic chloride, with argento-potassic cyanide, and with potassic bichromate. They may give rise, with iodurette hydriodic acid, to crystalline compounds often resembling those formed by the same reagent with certain vegetable alkaloids. They yield coloured reactions which, however, in certain cases are not produced according to the conditions of putrefaction. Of these coloured reactions the following are the principal:—Sulphuric acid, moderately concenrrated, gives a red-violet colouration. Hydrochloric acid, mixed with sulphuric acid and applied hot, a red-violet. Sulphuric acid and bromine water, a red colouration more or less distinct, which fades after a certain time. Nitric acid, gently heated and followed by potassa, gives a beautiful golden yellow. Iodic acid, sulphuric acid, and bicarbonate of soda form a violet-rose more or less distinct. These compounds are easily oxidised, and turn brown on exposure to the air, evolving a special urinous odour; at other times the smell is like that of conicin, and sometimes they exhale a perfume like that of certain flowers. They generally possess a pungent taste which benumbs the tongue; in some cases the flavour is bitter. Some of these compounds have no injurious effects upon animal life, but others are powerfully poisonous. The symptoms produced are transient

dilation of the pupils, slackening and irregularity in the pulsations of the heart, and convulsions. After death the heart is found contracted and void of blood.

Constitution of Ultramarine.—Jul. Philipp.—The author finds that green ultramarine may be transformed into the blue variety by the action of boric acid, of sal-ammoniac, and of chlorine. These facts seem to favour the view that green ultramarine differs from the blue by containing an additional proportion of sodic sulphide.

Extracts of Tannin.—A notice of the chief astringent extracts now met with in commerce. Among the principal kinds mentioned are the Mimosa-bark extract from Australia; that of so-called hemlock-bark (*Abies Canadensis*) from Canada and the United States, of which, in 1875, 6000 tons were imported into England. Extract of chestnut-wood is made by several firms in France and Germany, and contains about 18·5 per cent of actual tannin. In Jamaica a tanniferous extract is prepared from the leaves and branches of the pimento; and at Portland, in the State of Maine, the so-called sweet-fern (*Comptonia asplenifolia ?*) has been brought into use for the same purpose.

Regeneration of Deteriorated Albumen.—Albumen which has become partially insoluble may be restored by treatment, at 40°, with water containing 2·5 per cent of hydrochloric acid and 7·5 per cent of the stomachs of calves or sheep cut into shreds, the active principle being pepsine. After digestion for thirty-six hours the liquid is filtered off, and neutralised with ammonia.

MISCELLANEOUS.

Russian Scientific News.—Prof. Schöne has executed certain experiments referring to the action of hydrogen dioxide on oxygen compounds of thallium. It appears that the hydrogen dioxide in solution, or in the state of vapour, transfers Tl_2O into a brown insoluble thallic oxide. Thallious reagent-papers turn brown in the presence of ordinary air. This was before attributed to the action of atmospheric ozone; but as Schöne found that hydrogen dioxide has the same action on these papers, the presence of ozone in the air certainly cannot be strictly determined by means of them.

M. Eltekoff has obtained by the action of water and lead oxide on diamylen, a keton, $C_{10}H_{20}O$, boiling at 192° to 194°.

M. Wreden has transferred ordinary camphor by the action of dilute hydrochloric acid at 190° into a liquid isomer boiling at 187° to 193°, with a specific gravity 0·913 (at 0°). The compound only condenses at −17°, and solidifies at a much lower temperature. Such a solution absorbs oxygen from the air, especially in sunlight. The isomeric compound, on being boiled with an ammoniacal solution of silver nitrate, yields no silver mirror. At present the author is working out the theory of the formation of this curious compound.

SERGIUS KERN, M.E.

St. Petersburg.

American Association for the Advancement of Science.—Through the kindness of Dr. H. Carrington Bolton, we are able to announce that the twenty-seventh meeting of the association will be held at St. Louis, Missouri, commencing on Wednesday, the 21st of August, 1878. The following are the officers of the St. Louis meeting:—President—O. C. Marsh, of New Haven. Vice-President, Section A—R. H. Thurston, of Hoboken. Vice-President, Section B—A. R. Grote, of Buffalo. Chairman of Permanent Subsection of Chemistry—F. W. Clark, of Cincinnati. Chairman of Permanent Subsection of Microscopy—G. S. Blackie, of Nashville. Permanent Secretary—F. W. Putnam, of Cambridge. General Secretary—H. Carrington Bolton, of Hartford. Secretary of Section A—F. E. Nipher, of St. Louis. Secretary of Section B—George Little, of Atlanta. Treasurer—William S. Vaux, of Philadelphia.

Tokio University, Japan.—We have received from Mr. R. W. Atkinson the calendar of the Tokio University, Japan, which shows that the University is doing a great and useful work. In addition to the Law and Science departments (the latter including chemistry, engineering, mining, and biology), the hospital and medical school, under the charge of the educational department, have been incorporated with the University, and a department of literature, history, and philosophy has been formed. There are thus, at the present time, four faculties—law, science, literature, and medicine; and in accordance with this extension, the Japanese name has been altered from "Kai-sei-Gakko" to "Tokio Dai Gaku," the highest title which the language contains, and as far as it is possible to translate it into English, best rendered by "Tokio University." Before entering the University, the student has to pass through a four-years' course in the preparatory department, called the Yobimon, and, after a suitable and satisfactory examination is admitted to the Dai Gaku, the course of which is also of four years' duration, the subjects of the first year being the same for all students. At the conclusion of this year, the student states into which course he wishes to be admitted, and he thus receives three years' training in the official subject which he selects. Three students, last year, finished the three years course in chemistry. These are the first graduates which Japan has produced in her own country. The number would probably have been greater but for the fact that out of an original class of nine, five students were sent abroad to study, and one received an appointment in the country. The remaining three completed the course with satisfaction, and received their graduating certificates. An important part of the final examination is the composition of a thesis upon some chemical or technical subject connected with the country, each student being at liberty to choose his own subject, and during the last half-year to work at it experimentally in the laboratory. The three essays given in last year were on "Dyeing," "Pottery and Porcelain," and "Sugar," all of which showed a considerable amount of work done in the laboratory; the first, especially, treated of a good deal of new matter, as, hitherto no scientific examination of the dye-wares used in Japan has been made, and it was consequently necessary to identify each one. Last spring, evening lectures were commenced, and were continued through the winter session. Two are given in one month, one being in English, and the other given by one of the Japanese lecturers in their own language. They are well attended, the lecture hall, which holds about 500 persons, being usually crowded.

NOTES AND QUERIES.

Formic and Acetic Acids.—What is the best test to distinguish between formic and acetic acids, or to discover one of them if mixed with the other?—H. B. G.

Distillation of Shales.—Will any of your readers tell me the name of the best book on the distillation of shales, and the manufacture of mineral and the like kind of oils.

MEETINGS FOR THE WEEK.

MONDAY, June 24th.—Royal Geographical, 8.30.
TUESDAY, 25th.—Anthropological Institute, 8.
WEDNESDAY, 26th.—Society of Arts, 4. Anniversary.
— Society of Public Analysts, 8. "On the Detection of Alum in Flour." A. Wynter Blyth. "On the Assay of Carbolic Acid Powders," A. H. Allen. "Note on the Detection of Alum in Flour," Dr. Dupré. "Preliminary Note on the Nitrogen Salts contained in the Cereals," G. W. Wigner. "On the Detection of Alum in Flour," W. C. Young.
THURSDAY, 27th.—Royal Society Club, 6.30. Anniversary.
FRIDAY, 28th.—Quekett Club, 8.

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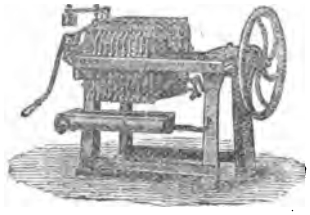

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The Gas Committee of the Corporation of Manchester are prepared to RECEIVE TENDERS for the PURCHASE of the AMMONIACAL LIQUOR to be produced at their Gaythorn and Rochdale Road Works during a period of one or more years, commencing from the 1st day of January, 1880. In addition to tenders for the purchase of the liquor in its crude state, the Committee will also be prepared to consider tenders for its disposal, either by manufacture into sulphate of ammonia at the above-mentioned works on their behalf, or in any other manner. The Committee reserve to themselves the option of accepting the offer the terms of which they deem most advantageous. They do not bind themselves to accept the highest or any tender. Sealed tenders, addressed to the Chairman of the Gas Committee, Town Hall, and endorsed "Tender for Ammoniacal Liquor," must be delivered at these offices on or before Thursday, the 1st day of August next.—Forms of tender and further particulars can be obtained on application to Mr. George B. Jackson, at the Gas Offices.—By order of the Gas Committee,

JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 31st May, 1878.

THE CHEMICAL NEWS.

Vol. XXXVII. No. 970.

ON AREOMETERS.*—Part II.

By P. CASAMAJOR.

(Continued from p. 244.)

Correction of the Indications of Areometers for Errors Resulting from Variations of Temperature.

The methods that I propose to give for the correction of the indications of areometers, when observations are made at temperatures differing from the normal, are applicable to all liquids; but, as I am not in possession of accurate data relating to the expansion of other liquids than pure water and sugar solutions, I shall confine myself to these. The application to any other liquid, however, is equally easy, if we possess sufficient data on its expansion by heat.

I propose to consider temperatures from 5° to 45° C. only, as these limits need never be exceeded in our laboratories.

At our December meeting† I gave the following table, of which the first column contains the degrees Centigrade from 5° to 45°; the numbers of the second column represent the total *absolute* contractions and expansions of 1 c.c. of water at every degree of temperature, starting from 15° C. as a normal, and the numbers of the third column represent the total *relative* expansions and contractions for the same temperatures. These last numbers were obtained by subtracting 0·000026, the cubic expansion of glass, as many times from the corresponding numbers of the second column, as there are units *minus* 15, in the number expressing the degree Centigrade. The numbers in this third column represent the visible expansion of water in glass vessels.

Table No. I.—Total Expansion from 15° C.

Degrees C.	Absolute Expansion.	Relative Expansion.	Degrees C.	Absolute Expansion.	Relative Expansion.
5.	0·000878	0·000612	26.	0·002445	0·002159
6.	0·000856	0·000622	27.	0·002717	0·002405
7.	0·000820	0·000612	28.	0·002995	0·002657
8.	0·000772	0·000590	29.	0·003279	0·002913
9.	0·000706	0·000550	30.	0·003569	0·003179
10.	0·000622	0·000492	31.	0·003869	0·003453
11.	0·000524	0·000420	32.	0·004181	0·003739
12.	0·000412	0·000334	33.	0·004503	0·004035
13.	0·000288	0·000236	34.	0·004836	0·004342
14.	0·000150	0·000124	35.	0·005180	0·004660
15.	normal	normal	36.	0·005533	0·004987
16.	0·000173	0·000147	37.	0·005895	0·005323
17.	0·000357	0·000305	38.	0·006265	0·005667
18.	0·000551	0·000473	39.	0·006644	0·006040
19.	0·000756	0·000652	40.	0·007032	0·006382
20.	0·000971	0·000841	41.	0·007428	0·006752
21.	0·001119	0·001039	42.	0·007832	0·007130
22.	0·001428	0·001246	43.	0·008244	0·007516
23.	0·001670	0·001462	44.	0·008664	0·007910
24.	0·001920	0·001686	45.	0·009092	0·008312
25.	0·002179	0·001919			

Referring again to the paper read before this Society in December, I will recall to your memory that by drawing a series of parallel equidistant lines, intersected another series of similar lines perpendicular to the first, by making the space between two vertical lines equivalent to 1° C., and the space between two horizontal lines equivalent to 0·0001 c.c., we were able to simplify the work of correcting the errors due to changes of temperature. We took on every vertical line a distance equivalent to the relative expansion corresponding to the temperature represented by that line, and we connected all the points thus obtained by a curve. Afterwards, by noting the points at which the curve intersects the horizontal lines representing 0·0005, 0·001, 0·0015, 0·002, 0·0025, &c., we were able to find the temperatures corresponding to these expansions as follows:—

Table No. II.

−0·0005	corresponds to	9·9°	Centigrade.
0·	,,	,, 15·00	,,
0·0005	,,	,, 18·20	,,
0·001	,,	,, 20·75	,,
0·0015	,,	,, 23·20	,,
0·002	,,	,, 25·30	,,
0·0025	,,	,, 27·30	,,
0·003	,,	,, 29·40	,,
0·0035	,,	,, 31·20	,,
0·004	,,	,, 32·80	,,
0·0045	,,	,, 34·50	,,
0·005	,,	,, 36·10	,,
0·0055	,,	,, 37·60	,,
0·006	,,	,, 38·80	,,
0·0065	,,	,, 40·40	,,
0·007	,,	,, 41·60	,,
0·0075	,,	,, 42·90	,,
0·008	,,	,, 44·20	,,
0·0083	,,	,, 45·00	,,

To enable us to make use of the data contained in Tables No. 1 and No. 2, let us examine what happens with an areometer floating in a liquid, when the density of the liquid varies on account of a change of temperature.

If we suppose that the temperature increases, the liquid will expand, and the areometer also, but everything will take place as if the volume of the areometer remained constant, and the expansion of the liquid was equal to the relative expansion of water in glass.

If we have an areometer which indicates specific gravities, and if we place it in pure water, at the normal temperature, 15° C., the instrument will sink to a point marked 1. If the temperature increases, the specific gravity of the liquid diminishes, and the areometer sinks deeper in the liquid. If, for instance, the temperature of the water is 35° C., we will find in the third column of Table No. 1 that at 35° 1 c.c. becomes 1·00466; consequently at 35° the specific gravity of water is—

$$\frac{1}{1{\cdot}00466} = 0{\cdot}9953.$$

As, before we have done with this subject, we shall have to correct the errors due to variations of temperature in the case of pure water, please to observe that, if the temperature is 35° C., and the indication of the areometer 0·9953, we will obtain the true specific gravity by multiplying 0·9953 by 1·00466.

I may also call to your attention that the correction may be more easily made by simply adding 0·00466 to 0·9953, which gives 0·99996, which is very approximately equal to 1.

If we wish to make use of Table No. 2, let us suppose that the temperature is 20·75°, at which 1 c.c. becomes 1·001 c.c. The specific gravity will then be—

$$\frac{1}{1{\cdot}001} = 0{\cdot}99908.$$

(very approximately 0·999). In this case we may rectify this indication of the areometer by multiplying it by 1·001. Please to notice, however, that the correction is, as above, more easily obtained by adding to 0·999 the number 0·001, placed opposite to 20·75° (0·999 + 0·001 = 1).

In the same way, if the temperature is 44·2° C., we find,

* Read before the American Chemical Society May 3, 1877.

† See Chemical News, vol. xxxv., pp. 130, 160, and 170.

opposite to it, the expansion 0·008, and the specific gravity of water becomes—

$$\frac{1}{1\cdot008} = 0\cdot99206,$$

very approximately 0·992. We may notice, again, that the correction is easily made by adding to 0·992, the expansion 0·008 placed opposite 44·2° C.

We may then make use of Table No. 2 by simply adding the numbers opposite to the temperatures observed, to obtain the correct reading at 15° C., in the case of pure water.

In the table marked No. 2 we have not, as in Table No. 1, every degree of the scale, but as the expansions corresponding to the temperatures in that table only differ by a quantity equal to 0·0005 c.c., no appreciable error is committed by taking the temperature in the table which comes nearest to the temperature observed.

Let us now take the case of an areometer with an even scale, and examine what happens when the liquid in which it floats is submitted to a change of temperature. If we had an areometer which would sink in pure water at 15° C., so that the liquid displaced was equal to 1 c.c., when the temperature of the water increased it would sink deeper, the extra volume of liquid displaced being equal to the relative expansion at the temperature observed, as shown in the third column of Table No. 1. If the volume of water displaced at 15° C. was 2 c.c., the increased volume of water to buoy up the areometer would be, for any temperature, the relative expansion of 1 c.c. at that temperature multiplied by 2. In more general terms, if the volume of water displaced at 15° C. was N cubic centimetres, the additional volume at any temperature would be the relative expansion, at that temperature, multiplied by N.

We have seen, however, that the divisions of an even scale are only equal volumes into which the total volume of the areometer is divided. Therefore, if we have an areometer with a total number of degrees, N, we may obtain the correction in degrees at any temperature by multiplying the total relative expansion at that temperature (Table No. 1, third column) by N, the total number of degrees.

In the preceding remarks I have always supposed that the temperature observed was above 15° C. If the temperature is below 15°, a contraction takes place, which is to be subtracted.

We may now proceed to apply the principle I have established to the correction of errors due to changes of temperature in the case of sugar solutions.

(To be continued.)

NOTE ON THE FERMENT-THEORY OF NITRIFICATION.*

By F. H. STORER, Harvard University.

THE results of the following experiments bear so immediately upon the recent observations of Schlösing† and Warington,‡ noticed in the April number of this Journal, that I am led to publish them by themselves, out of their legitimate connection with other experiments upon which I have been for some time engaged. My experiments were made for the purpose of testing the action of certain oxidising agents on ammonium compounds, and they are, perhaps, not the less interesting as a contribution to the ferment-theory of nitrification, inasmuch as they were undertaken without any reference to the observations of Schlösing, and not at all with the view of supporting or even of testing his experiment.

For my first trial, eleven common glass bottles of greenish tint, each of 500 c.c. capacity, and fitted with corks carrying inlet and outlet tubes, were charged as follows:—No. 1, with distilled water that had been carefully freed* from nitrates, nitrites, and ammonium compounds: No. 2, with a solution of ammonium chloride, containing 2-10ths m.grm. of NH_3 to the centimetre; No. 3, same as No. 2, with the addition of a quantity of ferric hydrate; No. 4, same as No. 2, with the addition of ferrous hydrate; No. 5, same as No. 3, with the addition of charcoal made from white sugar; No. 6, ammonium chloride, black oxide of manganese, and sugar charcoal; No. 7, leached peat and pure water; No. 8, leached peat and ammonium chloride; No. 9, leached peat and ferric hydrate: No. 10, leached peat, ferric hydrate, and ammonium chloride; No. 11, pure water.

Pure water was used in each case to dissolve or suspend the chemicals, and the absence of nitrates and nitrites was proved by testing each of the solutions and mixtures with iodo-starch, at the beginning of the experiment.

The bottles were about half filled with liquid, *i.e.*, each of them contained about 250 c.c. of the solution or mixture allotted to it.

The "leached peat" was prepared from some bog-meadow mud from the Bussey farm, which had been kept in barrels in a dry store-room for three or four years. This thoroughly air-dried substance was percolated with pure water until the filtrate gave no reaction for nitrites or nitrates.

The ferric and ferrous hydrates were used in the recently precipitated condition; they were made from the corresponding chlorides by precipitating with ammonia-water, in the cold.

The bottles were connected with one another, in the order indicated, with short pieces of caoutchouc tubing in such manner that by aspirating at No. 1 air could be made to bubble through the water in each member of the series. The corks of the bottles and the caoutchouc connectors were covered with shellac in alcohol, so that the entire apparatus was completely air-tight; that is to say, none of the solutions had the least connection with the external air, excepting as it was purposely admitted at the inlet-tube. To purify the air that was drawn into the apparatus, it was made to pass through a long tube loosely filled with clean cotton-wool; through two sets of Liebig bulb-tubes filled with a tolerably strong solution of yellow prussiate of potash, to remove ozone; through two sets of similar bulbs charged with potash-lye, to remove nitrates and nitrites; through a dry bottle, to catch liquid drawn forward from the potash bulbs; and through a large drying tube charged for two-thirds its length with calcium chloride and one-third with soda-lime.

By means of a Bunsen filter-pump a rapid current of air from out-of-doors was drawn incessantly night and day, through the series of bottles, for a fortnight, in September, 1877, in the direction from No. 11 to No. 1; at the end of which time the contents of each bottle were tested for nitrites and nitrates, by boiling with cadmium, distilling with acetic acid, and mixing iodo-zinc starch and acid with the distillate. 100 c.c. of liquid were taken for each of the tests, and fifteen minutes were allowed in which to watch for the appearance of the blue colouration. Nothing could be more distinct and decisive than the results of these tests. The solutions from bottles Nos. 8, 9, and 10, namely, gave immediate and strong reactions for the nitrogen oxides, while the contents of Nos. 1, 2, 3, 4, 5, 6, and 11 gave no reaction whatsoever. No. 7 gave a reaction, but not a very strong one. The reaction seemed to be strongest in the contents of No. 10. It appeared from these results that there had been formation either of a nitrate or nitrite in each of the bottles which contained humus, and no such formation in either of the other bottles; but the thought suggested itself that the small amount of nitrogen oxides found in No. 7 may per-

* From the *American Journal of Science and Arts*, vol. xv., June, 1878.

† *Comptes Rendus*, lxxxiv., 301.

‡ *Journal of London Chem. Soc.*, 1878, i., 74.

* In the manner described in the note on page 182 of vol. xii. of the *Amer. Journ. Sci. and Arts.*

haps have been dragged over mechanically from No. 8 by the current of air.

A second series of tests was made upon Nos. 8, 9, and 10, to see which of them gave the weakest reaction, 25 c.c. of liquid being taken from each bottle and diluted with pure water to the volume of 100 c.c. before applying the test. It appeared again that No. 10 gave the strongest reaction, and that No. 8 gave the weakest. Roughly estimated, the strength of the reactions from jars Nos. 10, 9, and 8 were to one another as 5 : 2 : 1.

It may here be said that humus was employed in these experiments for the sake of testing the old observation of Millon,* who noticed that ammonium salts are changed to nitrates when in contact with oxidising humus, and who argued that the chemical action, originated by the coming together of humus and oxygen, was communicated to the ammonium compound. In his own words—"The oxidation of the humic acid is the cause of the oxidation of the ammonia."

In so far as the foregoing experiments go, we have manifestly a striking confirmation of the accuracy of Millon's work. But on repeating the experiments—with the difference that the bog-earth was henceforth exhausted with hot, strong, muriatic acid, before proceeding to wash it with water—no such results as the foregoing were obtained. For example, in a second series of trials, arranged like the first, the contents of bottles Nos. 1 to 6 were identically the same as before, only that the amount of liquid was now 150 c.c. instead of 250 c.c. No. 7 contained the purified peat mixed with water; No. 8 was the same as No. 7, plus a quantity of gypsum; No. 9 was the same as No. 8, plus some ammonium chloride; No. 10 contained water alone; No. 11, purified peat, plus ammonium chloride and ferric hydrate; No. 12, well-washed cotton rags, plus ammonium chloride and ferric hydrate; No. 13, purified peat, plus ammonium chloride; No. 14, pure water; No. 15, pure water, the same, namely, which had already done service (as No. 11) in the first series of experiments.

The weather (October 13, 1877) being too cold to permit the keeping open of a window, the current of air, purified as before, was drawn from the cold-air box of the hot-air furnace used for warming the laboratory. The current of air passed this time in the direction from No. 1 to No. 15; it was maintained constantly during ten days, and the contents of the bottles were then tested as before for nitrites and nitrates. But no reaction was obtained in either instance, with the exception of No. 12 (cotton rags, &c.), which gave a faint colouration of a not very satisfactory character. After the application of the test, those of the bottles which still contained a sufficiency of liquid were re-attached to the aspirator, and air was drawn through them continually during another week, when the test for nitrites and nitrates was again applied. But in no case was there any reaction, with the exception of bottle No. 8, whose contents gave a faint colouration.

Inasmuch as warm, and, at times, hot summer weather had prevailed during the term of the first series of experiments, while the out-door air was decidedly cool, and that of the laboratory by no means very warm during the time allotted to the second series, a third set of trials was undertaken in December, 1877, in which the contents of the bottles where heated artificially. That is to say, the bottles were immersed in a large water-bath, which was heated to from 70° to 80° C. during the progress of the experiment.

In this third series, there were eight bottles containing the purified peat, first by itself, then admixed with gypsum; with gypsum and ammonium chloride; and with ammonium chloride and ferric hydrate. One bottle contained washed cotton rags, ammonium chloride, and ferric hydrate as before. The water-bath was heated during working hours for a fortnight, perhaps a hundred hours in all, and during this time air was drawn from the furnace-box and purified as before. The contents of the bottles were then tested for nitrites and nitrates, but no reaction was obtained in either case. To make sure that the absence of the reaction was not due to any interference caused by the presence of the peat or the chemicals, a fresh portion of liquid was taken from each of the bottles; enough nitrate of potash to amount to 0·001 grm. of N_2O_5 was added, and the test for nitrites and nitrates was applied in the usual way: reactions were now obtained immediately in every instance.

In the light of the facts observed by Schlösing, the natural inference from the results of these experiments is that the formation of nitrates or nitrites in bottles Nos. 7 to 10 of the first series of experiments was due to the presence of living organisms which the peat had harboured, and that the absense of nitrification in the other series of experiments is to be attributed to the destruction of the ferment-germs by the hot acid with which the peat employed in these experiments had been treated. It is to be observed, moreover, that the formation of nitrogen oxides in the bottles Nos. 7 to 10 is in nowise out of accord with the important fact observed by Warington, that darkness* is essential to the action of the nitrifying germs, for although my bottles were not shielded from diffused daylight, the mixtures of peat and water which they contained were practically dark coloured muds, not ill-fitted to shelter the germs from the light.

It is possible of course that the colder weather which prevailed during the later trials may have had an influence upon their results: but if this be so, the fact must be counted as an additional argument in favour of the ferment theory. Moreover, it may fairly be inferred that if mere oxidation be all that is needed to induce nitrification, the heating of the liquids by day in the third series of experiments would have been sufficient; though both the strong heat and the cooling of the bottles by night would have tended to prevent the growth of living organisms.

In the interest of the ferment theory, it would have been well to control the negative results above given by trials with mixtures of the purified peat and carbonate of lime, for peat which has been treated with muriatic acid has always a slight acid reaction, due I suppose to free humic acid, no matter how thoroughly it may have been washed with water, and it is to be supposed that this acid peat, devoid withal of phosphatic and other saline matters, is not favourable for the growth of the ferment. But, as was said before, my experiments were made to test the oxidising action of certain chemicals, not to cultivate living organisms.

It may be added that I have not as yet found any evidence that solutions of ammonium compounds can be oxidised to nitrites or nitrates by means either of ferric

* Kopp and Will's *Jahresbericht der Chemie*, 1860, xiii., 101, and 1864, xvii., 158.

* The following statement has a certain interest for analysts as bearing upon the stability of dilute solutions of ammonium chloride. In February, 1877, it was noticed by my assistant, Mr. Lewis, that a solution of ammonium chloride, which had been prepared ten or twelve months previously for use in connection with Nessler's test, by dissolving the salt at the rate of 3·15 grms. to the litre, now gave a strong reaction for nitrites, although freshly prepared solutions, made in the same way from like materials, gave no reaction. The old solution was contained in a glass stoppered vessel, which was about half-filled by it, and it had been kept most of the time in a dark cupboard.

Acting on the supposition that the change of the ammonium salt to a nitrite had been caused by the growth of some fungus in the liquid, and that such fungus might perhaps be present in other bottles in the neighbourhood, I collected as many different specimens of moulds as could be found growing in the various saline solutions kept in the laboratory, and, after rinsing with pure water, placed them in a series of half-gallon bottles, into which had been poured from half to quarter of dilute ammonium chloride, such as is used for Nesslerising. A quantity of mother of vinegar also was placed in a similar bottle. This series of bottles was left to stand during early autumn, and winter in a greenhouse, in a rather strong light, and the solutions were tested from time to time, at intervals of three or four weeks, but no reaction for nitrites or nitrates could ever be obtained from either of the bottles. The experiments of Warington show that these trials were vitiated by the strong light to which the bottles were exposed. It is not altogether unlikely that different results would have been reached if the bottles had been kept in the dark.

oxide, of black oxide of manganese, or of gypsum. I can say with Millon,* that, in spite of all that has been written in favour of the oxidation of ammonium by ferric oxide, "I owe it to truth to state that though the most varied attempts have been made to oxidise ammonia in the cold (*i.e.*, in the wet way), by peroxide of iron, they have all proved unavailing."

I am indebted to my assistant, Mr. D. S. Lewis, for his careful attention to the details of these experiments."

Bussey Institution, Jamaica Plain, Mass., April, 1878.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 20, 1878.

Dr. J. H. Gladstone, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed. The following gentlemen were duly elected Fellows of the Society:—E. R. Budden, C. T. Macadam, W. R. Criper.

The eleven following papers were read:—

"*Contributions to the History of the Naphthalene Series* (*No.* II. *β-Naphthaquinon*), by J. Stenhouse and C. E. Groves. In a previous paper the authors mentioned that nitroso-β-naphthol, when converted into the corresponding amido-naphthol and then submitted to oxidation, yielded a crystalline compound of the nature of a quinon; this substance was named β-naphthaquinon. The authors have obtained, by acting on this body, in a state of purity, with nitric acid sp. gr. 1·2, red crystals melting at 158°. This crystalline substance has the composition—

$$C_{10}H_5(NO_2)O_2,$$

mono-nitro-β-naphthaquinon; it is reduced by hydriodic or sulphurous acid, forming two new substances, probably the corresponding nitro-hydroquinon and the amido-hydroquinon. By treating β-naphthaquinon with dilute sulphuric acid a dark coloured compound was obtained, which, on reduction, yielded white acicular crystals, and on oxidation orange-coloured prisms, the three substances evidently standing in the same relations to one another as green quinhydron, quinol or hydroquinon, and quinon in the benzene series. The new quinon has the formula $C_{20}H_{10}O_4$, which the authors substantiated by analysis and quantitative experiment; it is very stable. The hydroquinon obtained by reducing the quinon forms colourless needles, oxidising with comparative ease, and becoming dark coloured on exposure to the air. Its formula is $C_{20}H_{10}(OH)_4$, and it may be regarded as a tetrahydric alcohol of the hydroquinon or quinol species, derived from a dinaphthyl, $C_{10}H_7C_{10}H_7$, by the displacement of four hydrogen atoms and four OH groups, and is a member of a new class of bodies, the diquinols. The authors propose to call it dinaphthyl-diquinol, and its quinon dinaphthyl-diquinon. Benzoquinon and α-naphthaquinon also yield diquinons and diquinols, which the authors are studying.

"*On Pyrotritaric and Carbo-pyrotritaric Acids*," by G. Harrow. The author has saponified diaceto-succinic ether with dilute sulphuric acid; he obtained a crystalline substance mixed with an oil. The oil was separated by distillation and dried; it boiled at 208° to 209°, had the formula $C_9H_{12}O_3$, and was decomposed by dilute soda into alcohol and an acid, $C_7H_8O_3$, melting at 135°. This acid proved to be the pyrotritartaric acid of Wislicenus and Stadincki (uvic acid of Böttinger). The silver and sodium salts were prepared and studied. The crystalline substance consisted of an acid, melting at 230°, crystallising from hot water in long needles, and having the formula $C_8H_8O_5$, and an ether of this acid crystallising in silky plates, which melt at 81° to 82°. The monobasic and dibasic silver and sodium salts of this acid were prepared. It proved to be carbo-uvic or carbo-pyrotritaric acid. On heating dry carbo-uvic acid, CO_2 was evolved, uvic acid being left. The reactions which occur on saponifying diaceto-succinic acid are then—

(1) $C_{12}H_{18}O_6+H_2O=C_8H_8O_5+2C_2H_5HO$,

(2) $C_{12}H_{18}O_6+H_2O=C_9H_{12}O_3+CO_2+C_2H_5HO+H_2O$.

In conclusion the author discusses the constitution of carbo-uvic and uvic acids.

"*On the Action of Alkaline Hypobromite on Ammonium Salts, Urea, and Oxamide*," by W. Foster. In the first part of the paper the author gives a *resumé* of our knowledge as to the action of hypobromite on ammonium salts and urea, detailing some experiments of his own which, in the main, confirm the results of previous observers, the reactions varying to a certain extent with the strength of the hypobromite solution. He then proceeds to investigate the action of alkaline hypobromite on oxamide; as a mean result he finds that oxamide gives off 74·87 per cent of its total nitrogen when it is acted on by the ordinary hypobromite solution. He then endeavoured to ascertain the precise condition of the suppressed nitrogen, but without complete success. The experimental evidence is in favour of the nitrogen remaining a nitrate, whilst general considerations point to the formation of cyanate. The author suggests as the formula of oxamide—

$$C_4\begin{cases}(NH)_3\\NHHO\\(HO)_3\end{cases}$$

"*Action of the Halogens at High Temperatures on Metallic Oxides*," by C. F. Cross and S. Suguira. The authors have investigated the action of the halogens on lead oxides by heating these bodies (1) in a mixture of the halogen and air, and (2) in the pure halogen. The products with bromine and chlorine were mostly liquid at the temperature employed; with iodine heavy infusible powders were formed. The authors draw attention to the constancy of the percentage of residual oxygen in the product of each series of reactions, thus:—

	Pure Halogen. P.c. of Residual Oxygen.	Halogen and Air. Per cent.	Ratio.
I compounds ..	4·12	5·63	1 : 1·3
Br ,, ..	1·43	2·14	1 : 1·5
Cl ,, ..	0·76	1·25	1 : 1·8

The action of iodine in the presence of oxygen upon oxides and carbonates of the alkaline earth metals is interesting, as, instead of (as with lead) oxyiodides being formed, periodates are produced; thus, calcium and barium periodates were obtained. In the absence of oxygen this fixation of iodine by the alkaline earths does not take place.

"*On Manganese Tetrachloride*," by W. W. Fisher. The author has studied the chlorides formed when the binoxide of manganese is dissolved in strong hydrochloric acid at the ordinary temperature; also the action of hydrochloric acid on red oxide of manganese. The results point to the conclusion that the oxides of manganese, higher in degree than the protoxide, when treated with an excess of strong hydrochloric acid, give brown liquids containing a highly chlorinated manganese compound, probably $MnCl_4$, which is readily resolved into manganous chloride and free chlorine, and that on dilution with water hydrated manganese binoxide is precipitated in each instance. Since a large of excess of hydrochloric acid or alkaline chlorides seem to render $MnCl_4$ more stable, it is probable that this body only exists in a combination analogous to chloroplatinic acid.

"*On Salts of Nitrous Oxide*," by A. E. Menke. The author has prepared the sodium salt of nitrous oxide

* Chem. News, 1860, ii., 337, from *Comptes Rendus*.

by fusing nitrate of soda with iron filings. Zinc was substituted for iron, but the salt was not formed. The sodium salt is very soluble in water, and crystallises in white needles; it has the composition $NaNO,3H_2O$. The silver salt previously obtained by Divers was prepared, and its composition confirmed. Details of the preparation and the reactions of the sodium salt are given.

"*Notes on Madder Colouring Matters*," by E. Schunck and H. Rœmer. The authors have prepared some quantity of munjistin from 100 lbs. of munjeet. In order to remove any doubt as to the identity of the colouring matter obtained from commercial purpurin with munjistin they have examined the latter substance with great care. It was obtained in golden yellow scales, melting at 231° C.; it had the same properties and composition as purpuroxanthic acid. Acetic anhydride forms, when boiled with munjistin, an unstable compound, melting at about 160°. Bromine forms orange-yellow needles, melting at 231°; its composition was that of dibrom-purpuroxanthin, the carboxyl group having been eliminated. Boiling potash forms with munjistin purpurin, and ammonia converts it into purpurinamide. By the action of fuming nitric acid orange coloured needles, melting at 251°, very similar to but readily distinguished by their behaviour to ammonium acetate from dinitro-purpuroxanthin.

"*On the Occlusion of Hydrogen by Copper*," by G. S. Johnson. The author has made an elaborate series of experiments to determine the causes of the discrepant results obtained by previous experimenters—Graham, Thudichum, &c. The principal facts established are the following:—When metallic copper is repeatedly oxidised and reduced by hydrogen in the same tube, progressively decreasing quantities of hydrogen are occluded. Thus, 37 grms. of copper wire gave, at first, 0·010 grm. water; finally, 0·004, until a constant minimum is reached. The variation in the quantity occluded does not depend altogether on the physical condition of the surface of the metal. At a red heat copper oxide occludes carbonic anhydride, and will not part with that gas in air at the temperature of occlusion or when reduced at a red heat by hydrogen. By fusion of the oxide the carbonic anhydride is evolved. In conclusion the author states that the discrepancy between the results obtained by different experimenters is explained (1) by the fact that hydrogenised copper retains nearly all its hydrogen *in vacuo* at a red heat; (2) that the same metal occludes varying quantities of hydrogen under different conditions. The amount occluded is, however, in most cases sufficient to introduce a serious error in organic analysis. The author recommends the plan of Dr. Thudichum for obviating this error, viz., ignition of the reduced metal in CO_2 for some time before use. The pure spongy metal reduced from precipitated oxide might be substituted for commercial copper.

"*On the Rôle Played by Carbon in Reducing the Sulphates of the Alkalies*," by J. Mactear. In 1839 Liebig suggested a process for the manufacture of carbonates founded on a discovery of Gay-Lussac, that caustic potash heated with sawdust evolves pure hydrogen, potassic oxalate and acetate being formed; by heating to redness these two salts are converted into carbonates. Liebig substituted sodium sulphide for caustic potash, and found that a similar reaction took place. The process, however, failed commercially. The author has investigated in detail the action of various quantities of carbon on the alkaline sulphates at various temperatures. When sulphate of soda is mixed with an excess of carbon and exposed to a temperature considerably above red heat out of contact with air, the reaction is—

$$Na_2SO_4+4C=Na_2S+4CO.$$

When a temperature of dull redness, 1150° to 1300° F., is used the action is—

$$3Na_2SO_4+6C=Na_2CO_3+Na_2S_2+Na_2S+4CO_2+CO.$$

The decomposition of sulphate of potash is similar but takes place at a lower temperature.

"*On the Action of Ethyl-chlor-carbonate on some Oxygenated Haloid Compounds of the Fatty Series*," by O'Neill F. Kelly. Some years ago Wurtz effected the synthesis of several aromatic monobasic acids by submitting a mixture of a monochlor or monobrominated hydrocarbon and ethyl-chlor-carbonate to the action of sodium amalgam, $CO.OC_2H_5$ being substituted for the haloid element. The author endeavoured to effect this substitution in di- and tri-substituted haloid hydrocarbons in the fatty series with the following results:—55 grms. of ethyl-chlor-carbonate and 54 grms. of allyl-alcohol dibromide were heated with 2·4 kilos. of sodium amalgam for five hours in a flask, to which a reversed condenser was attached. The evolved gases, after passing through bromine, were collected over water and found to consist at first of CO and CO_2, but finally of CO_2. Ethyl-carbonate, propylene, dibromide, and a trace of allyl-alcohol were the products of this reaction. Glycerin, dichlorhydrin, and ethyl-chlor-carbonate were the next substances experimented with. After heating twelve hours with sodium amalgam, the flask was cooled and water added, and the oil which separated washed and dried. On distillation one-third came over between 100° to 190°, and consisted of—

$$CO\begin{cases}Cl\\OC_2H_5\end{cases}$$

$CO(OC_2H_5)_2$, and $C_3H_5OHCl_2$. The portion which came over between 190° and 240°, after repeated fractionation, boiled at 225° to 230°; it consisted of $C_6H_{10}Cl_2O_3$. Some $C_2H_4Br_2$ was also obtained. No allyl-alcohol was formed. The author has confirmed the results of Hübner and Müller, that dichlorhydrin is converted by sodium amalgam at 100° C. into allyl-alcohol. Epichlorhydrin and ethyl-chlor-carbonate.—These substances when heated with sodium amalgam yielded $CO(OC_2H_5)_2$, boiling at 126°, and a mobile liquid with a bitter pungent taste, boiling at 145° to 150°, having the composition $C_6H_{10}O_3$, and yielding on saponification allyl-alcohol.

"*Laboratory Notes*," by H. E. Armstrong.

The Society then adjourned over the recess.

PHYSICAL SOCIETY.

June 22, 1878.

Professor G. C. Foster, Vice-President, and afterwards Prof. W. G. Adams, President, in the Chair.

The following candidate was elected a member of the Society:—Mr. F. W. Grierson.

Prof. W. G. Adams exhibited a new form of Polariscope, suitable for projecting on to a screen the figures formed by any crystal, and for measuring the angle between the optic axes. Parallel light from the electric lamp, after traversing a Nicol of about 2 inches aperture, is rendered divergent by a set of lenses. The crystal under examination is placed in a recess formed by removing a slice from the middle of a spherical lens, which is capable of motion in any direction about its centre, while any movement in the vertical plane passing through the axis of the instrument can be measured by a scale and vernier; and if, by such a motion, the point on the screen representing the position of one axis, when the two are in the vertical plane, be transferred to that indicating the position initially occupied by the other axis, we have at once a measure of the optic angle of the crystal, for the rotation of two plano-spherical lenses forming an exact sphere has no effect on the direction of the beam.

Mr. Walter Baily read a paper "*On the Effect of Starch, Salicene, Unannealed Glass, &c., on Polarised Light.*" In his experiments light was passed through a

Nicol prism, then through a quarter undulation plate, and then through a body having an optical structure symmetrical round an axis in the direction of the ray, such as any of the above-named substances. The axes of the quarter undulation plate being taken as axes of reference, ρ being the angle between the plane of polarisation and one of these axes, σ half the difference of retardation at a given point between the part of the light resolved in a plane through the axis of the body and the part resolved perpendicular to that plane, ϕ being the angle between an axis of the quarter undulation plate and the perpendicular on the axis of the body from the given point (which perpendicular is taken as the initial line in the equation to the ellipse defining the light at such point) and $r\,\theta$ being the co-ordinates of this ellipse, the writer finds the equation to the ellipse to be—

$$1+A\cos 2\theta+B\sin 2\theta=r^{-2}[1-(A^2+B^2)],$$

where $A=-\cos 2\rho\cos 2\phi$ and—

$$B=\sin 2\rho\sin 2\sigma+\cos 2\rho\cos 2\sigma\sin 2\phi.$$

From this equation diagrams have been drawn to exhibit the condition of the light at every point for different positions of the polariser. For the simple case of salicene or starch, in which the difference of retardation is the same, or nearly so, for all distances from the axis of the body, the diagram consists of a ring of ellipses of various eccentricities and inclinations, each ellipse showing the condition of the light along the radius on which it lies. For the general case, in which the difference of retardation is a function of the distance from the axis of the body, the diagram consists of two series of curves, one series being "isomorphal" curves, or curves along which the eccentricity of the ellipse is constant, and the other series being "isoclinal," or curves along which the inclination of the axis major of the ellipse to the perpendicular in the axis of the body is constant. The general equation to the isomorphal lines is $A^2+B^2=$constant, and to the isoclinal lines—

$$\frac{A}{B}=\text{constant}.$$

These two series of curves completely define the form and position of the ellipse of polarisation at every point, and render it easy to determine what appearances will be presented on passing the light through an analysing prism in any given position. The results obtained were illustrated by some experiments.

Prof. W. C. UNWIN made a communication on the flow from orifices at different temperatures. A paper recently appeared in the *Franklin Journal of Science* by Mr. Isherwood, giving results of experiments on this subject, and, according to him, the volume discharged from a given orifice is increased by about 12 per cent on raising the temperature from 60° F. to 212° F. It is difficult to accept this result, because the friction is known to diminish the discharge by an amount much less than 12 per cent, and no other cause than decrease of friction can be assigned to account for Mr. Isherwood's results. In the author's experiments the increase of discharge at 190° above that at 60° was only 4 per cent, with conoidal orifices in the form of the *vena contracta*. With thin-edged orifices the variation of discharge was still less. He is disposed to think that the great increase of discharge in Mr. Isherwood's experiments was due to diminution of friction in a rather small pipe leading to the orifices, and would not occur with any other arrangement.

Mr. GORHAM then read a paper "*On Complementary Colours.*" He stated that the three primaries are green, red, and blue, and not yellow, red, and blue; that yellow is a bihary compound of green and red; and that yellow and blue when mixed form white. He remarked that after looking at a green disc the eye evokes another colour, but this is not seen unless certain conditions are fulfilled; thus the undulations must be arrested by a gray surface. This was proved by an experiment, in which a green disc carrying a concentric ring, half white and half black, was caused to rotate, when a medium grey was produced, and this at once arrested and made visible pink, the complement of the green. Several other complementaries were shown by the same means. Mr. Gorham next showed how the greys can be formed by cancelling either reflected or transmitted rays of white light. The first of these cases is illustrated by white paper painted over with a wash of Indian ink, and the second by the well-known Berlin tiles, in which light and shade are obtained by giving varying thickness to the ware. He showed that this last effect may be imitated by piling strips of paper to varying heights, and he has succeeded in photographing geometrical figures so formed. Lastly, the author explained a method of arresting and showing the complementaries more satisfactorily than he considers has hitherto been done. Six thicknesses of white paper are gummed together and cut into a ring, a ring of the same size and shape being also cut from a disc of coloured paper, and the white ring is let in to fill its place. On observing such a disc by white transmitted light the complement is seen through the ring.

Prof. S. P. THOMPSON exhibited a series of magnetic figures illustrating electrodynamic relations. The lines of magnetic force around a wire carrying a magnetic current can be shown by passing a wire through a glass plate, strewing iron filings around, and tapping the plate gently. The filings may be fixed in their places, if the plate has previously been gummed and dried, by softening the gum with steam. Such a prepared plate may be used to project the figures of the magnetic curves in the lantern. Two parallel like currents attract, their curves forming a figure illustrative of the action; or they repel if travelling in opposite directions, the repulsion also being evident from the form of the curves. It was shown by a series of such lantern slides that a very large number of electrodynamic relations can be illustrated by curves produced in this manner. Figures were thrown upon the screen illustrating the law of oblique currents, the attraction of a magnet into or its repulsion out of a circuit, the deflection of a magnetic needle by a current, and the mutual tendency of a current and magnetic pole to rotate. A very curious figure was produced by a current running through a magnet longitudinally. A transverse section of the lines of force at a pole gave neither the radial lines of the magnet nor the circular lines of the current, but a series of spirals. It was argued that Faraday's conception of the lines of force tending to shorten themselves supplied the means of interpreting the physical effects indicated by the lines of force in the various figures.

The SECRETARY read a paper by Mr. C. H. HINTON "*On the Co-ordination of Space.*" If a cubical space be divided into 27 numbered cubes, and each of these be again subdivided in the same way, and so on, the position of any point within the initial cube can be expressed by a reference to the numbers of the several cubes in which it is placed, and the more this series of numbers is extended, the more accurately is its position defined. And further, if we consider an expression of the form—

$$\ldots\ldots r\,q\,p\,o\,n\,m\,.\,l\,k\,j\,i\,h\ldots\ldots$$

where each letter stands for any number from 1 to 27, and if m, before the dot, indicates the unit space, it will be evident that by such an expression the position of any point in space can be indicated with any degree of accuracy, each letter representing a space 27 times as great as that which immediately succeeds it; or, in place of 27, any other number offering special facilities for a given purpose may be employed. The author then gives some account of the manner in which the system can be utilised for classifying chemical phenomena and in arranging plants, &c.

An adaptation of the telephone and microphone for communicating vibrations to the phoneidoscope by Mr. TISLEY was then shown. The metal disc carrying the soap-film is fixed just above the telephone plate, and, this being in circuit with a microphone and battery, any vibra-

tion imparted to the microphone at once sets the soap-film in action, the characteristic figures being at once obtained.

Mr. A. HADDON exhibited a modified form of microphone which he has arranged with a view to make the same instrument available for receiving sounds of any given intensity. Its main peculiarity consists in having a thin strip of elastic attached to the middle of the pointed graphite. By varying the tension of this elastic the sensitiveness of the instrument can be accurately regulated.

The meeting of the Society was then adjourned until November.

CORRESPONDENCE.

SUGAR TESTS.

To the Editor of the Chemical News.

SIR,—The question about the absorption or non-absorption of sugar by bone-black having again arisen, and very considerable and persistent discrepancies having occurred in sugar tests by polarisation which can hardly be explained except by reference to the char, I have taken pains to collate such books as I happen to have in my office, and which bear upon the subject, with the following results, viz.:—

Dr. J. J. Pohl ("Anleitung zum Gebrauct des Mitscherlich'schen Polarizations Saccharimeters." Wien, 1858), gives the following directions for preparing solutions for polarisation, viz.:—"Coloured solutions must be decolourised (cleared), and for this purpose acetate of lead and animal charcoal are serviceable. [I omit the preparation and use of the lead solution, as there is no contested principle involved.] As a coal filter we use a glass tube 200 millimetres long and 20 m.m. internal diameter, contracted at the bottom, held fast in a vertical support, and having in its lower part a loose plug of cotton. Animal charcoal [no specific directions about burning or drying this are given], to the amount of 25 c.c., is put directly into the filtering-tube, and the fluid to be filtered is poured thereon. The first 30 to 35 c.c. that run off are weaker [in sugar, verdünnter] than the later filtrate, and the second part of the filtrate is used for determining in the saccharimeter the rotatory power of the solution."

In Mandelblüh's useful book ("Seiffaden zur Untersuchung der Verschiedenen Zuckerarten, &c." Brünn, 1867), we find the following directions, viz.:—After describing the use of lead, the author goes on to say that if the solution is steel-coloured filtration over charcoal is needed. "As a char-filter we use a glass tube 200 m.m. long and 20 m.m. wide, contracted at the bottom. In the contracted part is a plug of cotton, and upon this 25 to 30 c.c. of fine bone-char. Upon this the solution is poured. The first 30 to 40 c.c. are rejected, since these are weaker [in sugar, verdünnter] through the absorption by the char, and the second part of the filtrate is employed for investigation."

In "Saccharimetrie Optique, Chimique, &c." (par M. L'Abbé Moigno: Paris, 1869), we find the following:—After having directed that 49·50 grms. of molasses shall have been dissolved in 300 c.c. of water, the author goes on to say—"Animal charcoal in fine grains, to the amount of 80 c.c., is spread upon a filter, and all the solution is turned upon this filter. [This must be a gross error if the char takes up sugar, for *all* the solution is exposed to the action of the char, instead of reserving a portion.—J. M. M.] When an amount of solution about equal in bulk to the char has run through, the receiving-vessel is changed, and only the remainder of the filtrate is preserved. This is poured *ten or twelve times* [the italics are mine.—J. M. M.] over the char in order that it may be decolourised as thoroughly as possible." The author appears to use no lead solution.

Weiss ("Beitrage zur Quantitativen Bestimmung des Zuckers, &c.," 1874; and Wild, "Uber ein neues Polaristrobometer, &c.," 1865) discuss optical problems only, and I believe say nothing about the preparation of solutions. The same is in a measure true of Gautier's and Violette's treatises.

Emile Monier ("Guide pour l'essai et L'Analyse des Sucres." Paris. No date subsequent to 1864), speaking of the decolourising of molasses solutions for polarisation, says—"As the subacetate of lead does not completely decolourise the molasses, we re-filter the solution over perfectly dry bone-black."

Coming now to a more recent work ("Anleitung zur Untersuchung der für die Zucker Industrie in betract kommenden Rohmaterialen, &c." Von Dr. R. Fruhling und Dr. J. Schulz. Braunschweig, 1876), we find the following directions:—Assuming that acetate of lead does not sufficiently clear the solution, the authors says—"For such cases should be kept ready a pulverised and dry bone-char, whose action in respect to the absorption of sugar has been exactly determined by previous experiments. For 30 c.c. of the coloured filtrate [from the lead] 3 or 4 grms. of such coal are taken, put into a dry flask with the filtrate, shaken thoroughly, and filtered through a small dry filter." The authors then give directions to add to the result obtained by polarisation the coefficient of absorption of the coal, found by previous experiment. This seems to me a process at once exceedingly clumsy, and likely to introduce error. How much simpler and safer it is to adopt the method laid down in the earlier books, and used by myself in several thousands of tests, viz., to allow the first half or third of the solution to run away before taking a sample to test.

Direct experiments made by myself and my assistant, using both pure and commercial sugars, and employing a Soleil-Duboscq polariser and a Ventzke instrument of great delicacy, convince me that, with *well dried char*, the error introduced into the analysis, by neglect of the simple and well-grounded precaution of throwing away the first runnings, may amount to 1·4 per cent; an error wholly inexcusable.

Besides the books I have quoted the following papers may be consulted:—"Sostman Zucker bestimmung in gebrauchter Knochenkohle," *Zeitschrift fur Zucker-Industrie*, 1872, p. 259. "Rapport sur le Concours relatif a la Saccharimetrie, &c.," *Bulletin de la Société Encouragement*, April, 1848.

I propose to give my analytical results in a future note.—I am, &c.,

J. M. MERRICK.

59, Broad Street, Boston, U.S.A.,
June 8, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 20, May 20, 1878.

Part Played by Auxiliary Acids in Etherification. M. Berthelot.—The author remarks that Thenard and Scheele remarked that certain mineral acids, especially sulphuric and hydrochloric, have the property of determining the immediate combination of alcohol with the organic acids, such as the acetic, benzoic, &c. He has examined the conditions of the acceleration, the limits of etherification, and the distribution of the alcoho between the two acids.

Application of the Telephone on Board the "Desaix."—M. Trève.—By means of the telephone the *Desaix* has been able to communicate with her consort the *Argonaute*. The telephone has also been successfully used in diving operations, allowing the divers to report what they find or do without being obliged to ascend as was formerly necessary.

Alloys of Gallium and Aluminium.—Lecoq de Boisbaudran.—The author has prepared alloys of gallium with several metals, and has more particularly studied those of gallium and aluminium. If the proportion of the latter is to be considerable the two metals are heated together up to dull redness. The alloys thus obtained remain brilliant and do not sensibly absorb the oxygen of the atmosphere during their preparation. After cooling they are solid, but brittle, even when the excess of aluminium has raised the melting-point up to incipient redness. They decompose water when cold, but better at 40°, with rise of temperature, escape of hydrogen, and formation of a chocolate-brown powder, which is ultimately resolved into white flakes of alumina; almost the whole of the gallium is liberated in the form of globules, which appear quite free from aluminium. These alloys generally decompose water like an amalgam containing a medium proportion of sodium, but in certain cases the reaction is as brisk as with sodium itself. The escape of hydrogen caused by a solid alloy is considerably augmented by the contact of a globule of liquid gallium. A galvanic element is evidently formed of which the aluminium is the oxidisable metal. Superfused gallium dissolves aluminum even below 15°, forming very brilliant liquid or pastey alloys, not easily attacked by the air, but decomposing water very readily. As regards its alloys gallium seems to possess properties in common with mercury and lead.

Production of Liquid and Gaseous Hydrocarbons by the Action of Pure Water upon a Carburetted Alloy of Iron and Manganese.—S. Cloez.—Water alone acting when hot upon a carburetted alloy of iron and manganese yields its oxygen to the metals, forming at first protoxides, which pass ultimately, by the action of the air, to a higher stage of oxidation. Part of the hydrogen escapes in a free state, whilst the rest combines with the carbon to produce hydrocarbides analogous to those found in the earth, and known as petroleum.

On an Induction Machine.—M. Gaiffe.—A modification of the arrangement of the electro-magnet adopted by M. Siemens.

Detection of Ozone in the Atmosphere.—Albert Levy.—The author maintains that the ozonoscopic paper may be safely used when exact determinations are not required.

On an Allotropic Modification of Copper.—P. Schützenberger.—The modification in question is obtained by the electrolysis of certain cupreous solutions. It is less red than ordinary copper, brittle, absolutely devoid of malleability, and of the specific gravity 8·0 to 8·2. If washed with water and exposed to the air it is oxidised with great rapidity. Pure nitric acid diluted with ten parts of water attacks it very strongly, with the escape of protoxide of nitrogen almost pure, the metal becoming covered with a blackish olive layer. Ordinary copper is scarcely attacked at all by so weak an acid; with a stronger acid it evolves nitric oxide. Heat, or the prolonged action of dilute sulphuric acid, converts this abnormal metal into ordinary copper.

On "Pelletierin," an Alkaloid from the Bark of the Pomegranate Tree.—M. Tanret.—This alkaloid is volatile and powerfully basic, forming well-defined salts. It precipitates the chlorides of palladium and of gold, but not that of platinum. It gives a white precipitate with the salts of lead, mercury, zinc. and silver, the two last being soluble in an excess of pelletierin. Its composition has not been determined. (We cannot approve of M. Tanret's new principle of chemical nomenclature.)

On a New Synthetic Method for the Formation of the Carbides of Hydrogen.—Fr. Landolph.—The fluoboric compounds of the carbides of hydrogen, such as fluoborethylen, easily react upon oxygenated organic compounds capable of yielding carbides of dehydration. The powerful affinity of boron for the elements of water sets up these reactions, and enables us thus to obtain synthetically a great number of the carbides of hydrogen.

Berichte der Deutschen Chemischen Gesellschaft, No. 4, 1878.

Further Communications on Ornithuric Acid and its Derivatives.—M. Jaffé.—An examination of the ornithurates of lime and baryta, and of a base which the author names ornithin.

Difference in the Attraction of Caustic Soda and Chloride of Calcium for Water.—W. Müller-Erzbach.—The attraction of caustic potassa for water is intermediate between those of caustic soda and of chloride of calcium.

No. 5, 1878.

Molecular Constitution of Vapours, in Reply to Horstmann's Criticisms.—Alex. Naumann.—The writer points out that Horstmann has confounded molecular weight with vapour density.

Comparison of ε-Purpurin with Purpuroxanthincarbonic Acid, and on Anthraflavon.—E. Schunck and H. Römer.—The authors, in opposition to H. Rosenstiehl, regard ε-purpurin not as a chemical individual, but as a mere mixture, and consider that his α-anthraflavon must be meta-benz-bioxy-anthraquinon.

Determination of Nitrous and Nitric Acids.—G. Lunge.—This paper cannot be fairly abstracted without the accompanying engraving. The author criticises the process described by Mr. Davis (CHEMICAL NEWS, xxxvii., 45). He maintains that without the correction for temperature and barometric pressure an error of 10 per cent would frequently occur at Zürich, and complains that Mr. Davis has not given in proof of the accuracy of the method the analysis of any pure substances, or of such as had been mixed with known quantities of impurites.

Chemical Examination of the Water of the Danube at Buda Pest.—M. Ballo.—The author observes that the amount of suspended matter is directly proportionate to the height of the river, whilst the dissolved substances vary in the inverse proportion. One litre, taken in the middle of November, 1872, contained:—

Calcium bicarbonate	0·1277
Magnesium „	0·0633
Calcium sulphate	0·0292
Sodium chloride	0·0035
Ferric oxide	traces
Silicic acid	0·0018
Free carbonic acid	0·0163

"besides ammoniacal salts, nitrates, and organic matter," the quantity of which is not given.

Behaviour of Tetra-chlor-ether and Acetyl-chloral-alcoholate with Potassium Cyanide and Alcoholic Potassa.—J. Busch.—The action of potassium cyanide upon tetra-chlor-ether is feeble. The quantity of ether employed is almost entirely recovered unchanged, whilst the residual liquid smells strongly of isonitril. The reaction of alcoholic potassa is more effective. An unsaturated ether is obtained, which, under water and in closed vessels, remains almost unchanged, whilst in the air it takes a pungent odour, though its boiling-point (154° to 156°) remains unaltered. Treatment with hydrochloric acid gas does not reconvert it into tetra-chor-ether.

Products of the Dry Distillation of Calcium Pimarate.—G. Bruylants.—The author has obtained by the dry distillation of this salt, not merely the following

products belonging to the fatty series, ethylen, propylen, amylen, ordinary aceton, methyl-ethyl-keton, and diethyl-keton, but also hydrocarbons of the aromatic series, such as toluol, dimethyl-benzol, methyl-ethyl-benzol, and hydrocarbons of the camphoric groups, such as tereben and ditereben.

Connection of the Chemical Compounds in Volatile Oils.—G. Bruylants.—The author undertakes to show that a relation exists between the component parts of one and the same oil. We may in general assume that the hydrocarbon is the original chemical individual from which alcohols, aldehyds, acids, &c., are derived by processes of hydratation, oxidation, or reduction, perhaps during the life of the plant. The author gives the results of his researches on the oils of valerian and of tansey.

On Pyroxanthin.—H. B. Hill.—Pyroxanthin, after recrystallisation from alcohol, forms fine, shining, orange-yellow needles, with a bluish reflection. From a solution in boiling benzol it is obtained in large reddish yellow monoclinar prisms. Its composition may be represented by the formula $C_{15}H_{12}O_3$. If boiled with zinc-powder and glacial acetic acid diluted with a little alcohol it forms a colourless solution, from which water precipitates a white voluminous substance, probably hydro-pyroxanthin.

On Borneo Camphor.—J. Kachler.—The author is engaged with a comparative examination of the natural Borneo camphor of *Dryobalanops Camphora*, and of the borneol obtained by Baubigny's method from the camphor of the Laurineæ. He finds that both borneols yield with phosphorus pentachloride or with strong hydrochloric acid identical chlorides, $C_{10}H_{17}Cl$, which melt at 147° to 148°. This chloride is readily decomposed if heated in tubes to 100° along with water, yielding hydrochloric acid and a solid camphin, $C_{10}H_{16}$, which melts at 51° to 52°, and boils about 160°.

A New Indicator in Alkalimetry.—W. v. Miller.—The indicator proposed is tropeolin, a new colouring-matter discovered by O. Witt, and manufactured by Messrs. Williams, Thomas and Dower. The shade known as 00 is characterised by its behaviour with concentrated sulphuric acid, which turns its aqueous solution from a yellow to a crimson red. According to the author this reaction is common to all the mineral acids, even dilute, and to certain organic acids, especially the oxalic. Hence this variety of tropeolin is a valuable indicator in alkalimetrical titration, as has been proved by a series of comparative experiments with this colour and with litmus. The alkaline liquid to be titrated is mixed with an aqueous solution of tropeolin containing 0·05 per cent of the colour, so that 2 c.c. of tropeolin solution are added to 50 c.c. of the liquid to be analysed, and the acid is dropped in till the light yellow colour of the solution changes suddenly to a yellowish red. The point cannot be overlooked, for the transformation of colour is too striking, and the addition of a further drop removes all doubt by converting the orange colour into a decided red. Tropeolin can be preserved either in the dry or the wet state, and has the decided advantage that it is not affected either by acid carbonates or free carbonic acid. Hence the alkaline carbonates can be titrated without the aid of heat. If tropeolin is used as an indicator a normal solution of sodium carbonate may be used instead of one of a caustic alkali, which is difficult to preserve. Further, tincture of litmus is reddened not merely by free acids, but by neutral metallic salts, whilst the yellow solution of tropeolin is turned red only by free acids, solutions of metallic salts having no effect.

Oxidation of Xylol-sulphosamids (Third communication).—W. Iles and Ira Remsen.—An examination of oxytoluylic acid and its salts.

Compound Obtained by the Interaction of Aceton, CyK, CySK, H_2O, and Aqueous Hydrochloric Acid.—F. Urech.—The compound in question, $C_5H_7NO_2S$, forms snow-white crystals, which melt at 152°. If heated to 120° along with concentrated hydrochloric acid under pressure it is resolved into carbonic acid, sulphuretted hydrogen, acetonic acid, and sal-ammoniac.

Formulæ of the Xylol-sulphamids.—Ira Remsen.—A hypothetical paper.

Nitro-derivatives of the Hydroquinons.—R. Nietzki.—The author, on treating an acetylised hydroquinon with nitric acid, obtained a nitro-derivative, which crystallises from alcohol in fine sulphur-yellow needles, melting at 96°, and which on treatment with cold dilute caustic alkali yields a splendid violet-blue liquid, turning to a golden-yellow on the addition of acids.

Synthesis of the Aromatic Sulphones from the Chlor-anhydrides of Sulphonic Acids and Hydrocarbons by the Action of Aluminium Chloride.—H. Beckurts and R. Otto (Preliminary notice).—The authors find that the process of MM. Friedel and Crafts is well adapted to effect the synthesis of sulphones.

On Aurin.—E. and O. Fischer.—Leucanilin prepared from pure aurin, on the decomposition of its diazo-compound by the addition of alcohol, yielded a crude hydrocarbon, from which the authors have succeeded in obtaining pure triphenyl-methan.

On Invertin.—M. Barth.—The author has isolated and analysed this ferment, which he finds composed of—

Carbon	43·9
Hydrogen	8·4
Nitrogen	6·0
Sulphur	0·63
Oxygen	41·17
	100·10

He has also compared its action with that of other ferments and finds that it is slower and more feeble than many especially emulsin.

On Atmospheric Hydrogen Peroxide.—E. Schœne. (Second communication).—The author concludes that when the barometric minimum, which affected the state of the weather in Moscow, lay to the north of that city the rain and snow contained on an average more hydrogen peroxide than when such minimum lay to the south.

Sulphin Compounds of Thio-urea.—A. Bernthsen and H. Klinger.—The authors, from the result of the reaction between certain thio-urea compounds and mercuric oxide, consider it probable that the constitution of these addition-products resembles that of the sulphin bases.

Potassium Cyanide and Dibromo-succinic Ether.—A. Claus and Fr. Calliess.—The final product was succinic acid. The authors did not succeed in isolating dicyano-succinic acid.

Potassium Cyanide and Dichloracetic Ether.—A. Claus and R. Weiss.—The results are decidedly opposed to the formation of a dicyanacetic acid.

Formation of Dichloracetic Ether from Chloral.—A Claus.—An inquiry into the conditions under which cyanogen can be introduced into organic compounds.

Occurrence of Allantoin and Hippuric Acid in the Urine of Dogs.—E. Salkowski.—The author finds the urine of dogs, under normal circumstances, free from allantoin. Hippuric acid was observed in the urine of dogs confined entirely to a flesh-diet, though the maximum amount did not exceed $\frac{1}{15}$ of the urea secreted.

Action of Phosphorus Penta-sulphide upon Amides.—A. Bernthsen.—The reaction of phosphorus penta-sulphide with amides affords a new process for the preparation of thiamides.

Remarks on the Previous Paper.—A. W. Hofmann.—A personal communication.

Monileur Scientifique Quesneville.
May, 1878.

Carbonisation of Vegetable Matter mixed among Wool by means of Aluminium Chloride.—This process, invented some years ago by M. Joly, of Elbeuf, is decidedly superior to those in which free acids are employed, as the colours are not attacked, and there is no fear of stains. The wool is impregnated with a solution of aluminic chloride at 6° or 7° Baumé, drained in a centrifugal, and dried in a stove at 100° to 125°. It is afterwards washed to remove the chloride.—*Deutsche Wolltengewerbe.*

Cerulein and Gallein.—These two dyes are at present manufactured on the large scale at Bâle. According to M. H. Kœchlin, gallein yields, in printing, rose and violet shades which resist soap very well. With a chrome mordant fuller shades are obtained, and with salts of iron a pleasing grey. Cerulein dyes olive shades with mordants of alumina (?) and of iron: it is thus the first colouring-matter which gives directly a green. It resists the action of light and of soap well. Cerulein is very sparingly soluble in water, but dissolves well in water to which has been added a quantity of sodium bisulphite solution of sp. gr. 1·39 equal in weight to the dye-ware to be used. In this case ceruline, a reduction-product, is doubtless formed.

Novel Blue Dye from Anthracen.—According to the *Muster-zeitung* Dr. Springmühl has discovered a splendid blue colouring-matter among the derivatives of anthracen, or rather of some compound not thoroughly known which accompanies anthracen and resembles it in most respects. The preparation of the new dye as described is long and complicated, and the product does not appear to have been submitted to analysis.

Reimann's Färber Zeitung,
No. 21, 1878.

The new dye "aurantia" is now declared to be free from poisonous properties.

By a process recently patented, but the full specification of which has not yet been published, the operation of Turkey-red dyeing has been shortened to one day.

Chemiker Zeitung.
Jahrgang ii., No. 14.

According to the recent experiments of A. Frisch, *Micrococci*, *Bacteria*, and *Bacilli* are not destroyed even by a temperature of −87·5°. No disinfecting action can therefore be produced by cold.

MISCELLANEOUS.

Sewage Farming at Gennevilliers, Paris.—The proceedings undertaken by M. Greyveldinger against the City of Paris ou account of the alteration of the place for obtaining water at Epinay—a change due to the diversion oi the sewage into the Seine at Clichy and at St. Denis—have just terminated, after a duration of twelve years, by the condemnation of the City of Paris. On July 26th, 1876, the Council of the Prefecture of the Seine, after having heard M. de Valroger, advocate of the Commune of Gennevilliers, ordered a scientific investigation, and by its decree of the said date laid before the experts the questions following:—

1. To what cause must be ascribed the inundations which are produced in the cellars? The experts will especially consider the comparative height of water in the wells of Gennevilliers, and in those of circumjacent localities; they will decide if the underground waters have been raised above their natural level by reason of the diversion of the sewage.
2. If an alteration due to such diversion has been discovered in the quality of the well-waters.
3. If the sewage occasions an offensive odour.
4. If it gives off emanations capable of occasioning intermittent fevers; and in general they will examine if the diversion of waters coming from the sewers of the City of Paris, on to the plain of Gennevilliers, may be a cause of inconvenience and ill-health for the inhabitants of the Commune.

The Council of the Prefecture appointed three experts, among whom were MM. de Lagrené and Boussingault. These gentlemen having declined to act, the Council selected MM. Müller, Huttean, and Petiton, who, after a long and conscientious examination, have just presented their report. We have obtained information of this at the Registry of the Prefecture, and we can without any indiscretion announce to those concerned that this report is favourable to the Commune of Gennevilliers. MM. the Experts unanimously conclude that the effect of the diversion of the sewage produces at Gennevilliers a mean rise of the underground waters of from 90 centimetres to 1 metre 25 centimetres. They do not think that the alteration of the water in the wells is imputable to the said diversion. They declare that the sewage diffuses an offensive odour. They do not decide on the question whether the sewage diffuses emanations capable of occasioning intermittent fevers, but they do not hesitate to express their opinion that the diversion is a cause of inconvenience and ill-health to the inhabitants. MM. the Experts sum up their report with the general conclusion that the diversion of the sewage has raised the level of the underground waters, and that the best means of avoiding this inconvenience is a regulation of the distribution of the waters combined with rational drainage. We shall return to this important document, which comprises no less than 150 pages of text, besides illustrative plans.

Manchester and Salford Sanitary Association.—This Association has determined to widen its sphere of usefulness by instituting a Sanitary Inspection Department, the objects of the Department being, *first*, to provide its members, at moderate cost, with such advice and supervision as may ensure the proper sanitary condition of their own dwellings; *secondly*, to enable members to procure practical advice, on moderate terms, as to the best means of remedying defects in houses of the poorer classes, and any other premises in which they are interested. Persons may become members of the Department upon payment of an annual subscription of £1 1s., which gives the privilege of an annual inspection and written report by an engineer of the Association, on the sanitary condition of one dwelling or tenement, with specific recommendations, if necessary, as to the improvement of drainage, water supply, and ventilation; and of reports by the Officers of the Association as to the sanitary condition of any dwelling or tenement designated by any member, on payment of a fee of 2½ per cent on the rent for the first inspection, and 1 per cent for any subsequent inspection. The sanitary condition of the country would be speedily improved if other towns would follow this excellent example of Manchester.

NOTES AND QUERIES.

Formic and Acetic Acids.—(Reply to H. B. G.)—The best test for the distinction of formic and acetic acids when mixed together is to make the solution neutral, and add $AgNO_3$. The white precipitate of $C_2H_3AgO_2$ will be soluble in hot water, whilst the precipitate $CHAgO_2$ will rapidly darken, and metallic Ag will be produced. —A. E. Menke

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END OF VOLUME XXXVII.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XXXVIII.—1878.

LONDON:
PUBLISHED AT THE OFFICE, BOY COURT, LUDGATE HILL, E.C.
AND SOLD BY ALL BOOKSELLERS.

MDCCCLXXVIII.

LONDON:

PRINTED BY EDWIN JOHN DAVEY,

BOY COURT, LUDGATE HILL E.C.

THE CHEMICAL NEWS.

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EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 971.—JULY 5, 1878.

ATTEMPTS TO PREPARE ALUMS CONTAINING ANILINE AND ROSANILIN.

By W. H. WOOD, Senior Assistant, Chemical Laboratory, Yorkshire College, Leeds.

I. *Aniline.*

1. THE analogy existing between the combinations formed by ammonia, methylamin (considered as a type of the primary monamines of the methyl series), and aniline are well known, resulting, as they do according to theory, from the similarity of their constitution. Thus, comparing the combinations of ammonia and aniline, we have—

Ammonia—

$N\begin{cases}H\\H\\H\end{cases}$, NH_4Cl, NH_4NO_3, $(NH_4)_2SO_4$, $(NH_4)_2C_2O_4$, $(NH_4Cl)_2PtCl_4$,

Aniline—

$N\begin{cases}(C_6H_5)'\\H\\H\end{cases}$, $NH_3(C_6H_5)'Cl$, $NH_3(C_6H_5)'NO_3$, $[NH_3(C_6H_5)']_2SO_4$, $[NH_3(C_6H_5)']_2C_2O_4$, $[NH_3(C_6H_5)'Cl]_2PtCl_4$.

Base. Chloride. Nitrate. Sulphate. Oxalate. Chloroplatinate.

Methylamin and ethlyamin form analogous compounds. Ammonia and the bases just mentioned likewise enter into combination (as sulphates) with the sulphates of the metals aluminium, chromium, iron, and manganese,* containing two equivalents of metal to three equivalents of SO_4, forming alums of the general formula—

$$\underline{M}_2(SO_4)_3\underline{N}_2H_2SO_4.24H_2O,$$

where $\underline{M}$ = Al, Cr, Fe, or Mn, and $\underline{N}$ = NH_3, CH_5N, or C_2H_7N.

2. It was considered a subject of sufficient theoretical importance to determine whether the parallelism existed with respect to the formation of alums containing aniline, on which point no experiments appear to be recorded. With this object the following experiments were made:—It will be observed that aluminium sulphate was alone used, along with aniline sulphate in endeavouring to obtain the double salt, the reason being that alums containing aluminium are usually obtainable with greater facility and are more stable than those into whose composition chromium, iron, or manganese enters; consequently any deductions which follow in the course of this paper apply only to aluminium sulphate.

3. The first experiment was made with commercial sulphates of aniline and aluminium. 14·2 grms. of commercial aniline sulphate were taken and dissolved in 40 c.c. of hot water. This solution was then mixed with 36·63 grms. of aluminium sulphate, dissolved in 120 c.c. of hot water, the weights mentioned being in the proportion of $(C_6H_7N)_2H_2SO_4$ to $Al_2(SO_4)_3,18H_2O$. The mixed solution was placed in an evaporating dish over strong sulphuric acid, to evaporate and crystallise over night. Next morning the solution was in great part crystallised, the crystals were drained, re-dissolved, filtered after addition of a little animal charcoal to decolourise the solution, and the solution evaporated. The crystals thus obtained were dried between filter-paper, after draining thoroughly, and tested qualitatively for Al, C_6H_7N, and SO_4, all of which were shown to be present. The amount of SO_4 they contained was then estimated by precipitating as barium sulphate and weighing:—

a. 0·2170 grm. of crystals gave—
0·2175 grm. $BaSO_4$ = 33·06 per cent SO_4.

b. 0·1975 grm. of crystals gave—
0·1565 grm. $BaSO_4$ = 32·77 „ „

Mean .. .. .. 32·915 „ „

Theory requires for $(C_6H_7N)_2H_2SO_4$ 33·802 „ „

And for—
$(C_6H_7N)_2H_2SO_4Al_2(SO_4)_3,24H_2O$ 36·250 „ „

4. The above analytical results appearing to indicate that the crystals were practically aniline sulphate with a little aluminium sulphate as an impurity. Further experiments were made with a view to test the validity of this conclusion; first, with pure aniline sulphate (prepared from pure aniline) and commercial aluminium sulphate, and afterwards with pure aniline sulphate, together with pure aluminium sulphate. The pure aniline was

* Perhaps it would be more correct to say that ammonia forms these compounds, and that there is every probability of methylamin and ethylamin forming similar ones, as their sulphates have been obtained in combination with $Al_2(SO_4)_3$.

obtained from pure aniline hydrochlorate,* by adding sodium hydrate in excess, separating the liberated aniline by means of a separating funnel, and distilling in a current of hydrogen; aniline and water first distilled, then aniline almost colourless. The distillate was fractionated, water and aniline distilled at 100° to 104° C.; the temperature then quickly rose to 184° to 185° (uncorrected), at which point it remained stationary until the whole of the liquid had passed over. Aniline free from water and quite colourless was thus obtained as a highly-refracting oily liquid.

5. About 12 grms. of the aniline so obtained were mixed with the quantity of pure sulphuric acid (slightly diluted) requisite to neutralise it, and a saturated solution of the aniline sulphate prepared by addition of boiling water, the solution being aided by heating. A hot saturated solution of commercial aluminium sulphate was also made, the amount used being that requisite to form the alum with the aniline sulphate; to this solution the solution of aniline sulphate was added, the mixture heated to boiling for some time, and then filtered. The filtrate was of a brown colour, and speedily deposited needle-shaped crystals on cooling. The crystals were drained and re-dissolved, a small quantity of animal charcoal added to the solution,† which was then boiled and filtered. Crystals—plates and needles—having a pearly hue separated out from the filtrate; these were allowed to drain, dried between filter-paper, and the percentage of SO_4 determined.

a. 0·9690 grm. of salt gave—
0·777 grm. $BaSO_4$=33·075 per cent SO_4.

b. 0·4975 grm. of salt gave—
0·404 grm. $BaSO_4$=33·447 „ „

Mean .. .. .. 33·261 „ „

By precipitation with ammonia before determining the SO_4 *a* gave 0·004 Al_2O_3=0·413 per cent, while *b* gave a barely weighable quantity, showing that aluminium was simply present as an impurity.

Some of the crystals just analysed were subjected to a second solution, filtration, and re-crystallisation, the result on analysis being:—0·5555 grm. of salt gave 0·4560 grm. $BaSO_4$=33·807 per cent of SO_4; theory requires for aniline sulphate 33·802 per cent SO_4. The product was therefore aniline sulphate in a state of purity.

To determine the amount of non-volatile matter (Al_2O_3, &c.) in the original specimen from which this last was prepared, a weighed quantity was heated in a platinum crucible until all organic matter was burnt off.

2·021 grm. of salt gave on ignition 0·040 grm. of residue. Assuming this to be pure alumina it is equal to 1·979 per cent Al_2O_3; but after heating with $KNaCO_3$ (free from SO_4), dissolving in water, and acidifying with HCl, $BaCl_2$ gave a tolerably abundant precipitate of $BaSO_4$, showing that even this small residue was by no means pure Al_2O_3. It is evident, therefore, that the salt contained less than 1 per cent Al_2O_3 as indicated by the determination previously quoted.

6. To obtain pure aluminium sulphate, ammonia alum was dissolved in hot water, the solution heated to boiling, and $Al_2(HO)_6$ precipitated by addition of excess of ammonia; after boiling, the precipitate was allowed to subside, the liquid run off by means of a syphon, hot water poured on, and the washing continued by decantation until the wash-water was free from sulphates. The precipitate was then collected upon a filter, and dried in a water-bath. A weighed quantity was then heated in a platinum crucible to determine the amount of water it contained, when 0·9215 grm. lost 0·3428 grm. of water = 37·20 per cent. The aluminic hydrate consequently contained 1 equiv. Al_2O_3 to rather more than 3 equivs. H_2O. Nearly 5 grms. of the hydrate were taken, mixed with the requisite quantity of sulphuric acid to form $Al_2(SO_4)_3$. This dissolved in the smallest possible quantity of water, and to it was added the proportionate quantity of pure aniline sulphate (made as before by adding pure slightly diluted sulphuric acid to pure aniline) also dissolved in the smallest possible quantity of water. The mixture was next evaporated down, and then allowed to cool. The crystals obtained were drained and divided into two portions A and B.

The portion A was washed several times with *hot* water until the greater part was dissolved. The solution (*a*) was then evaporated and re-crystallised. The crystals (*b*) remaining undissolved were also re-crystallised, and the amount of SO_4 contained in the two products determined.

a. 1. 0·6458 grm. of salt gave—
0·5123 grm. $BaSO_4$=32·684 per cent SO_4.
2. 0·7453 grm. of salt gave—
0·5890 grm. $BaSO_4$=32·560 „ „

Mean .. .. 32·622 „ „

b. 0·1385* grm. of salt gave—
0·1030 grm. $BaSO_4$=30·945 „ „

All the results more nearly approach to aniline sulphate than to aniline alum.

The portion B was washed three or four times with *cold* water, which dissolved more than half. The solution (*a*) was evaporated down, and crystallised on cooling, the mass presenting the appearance of aluminium sulphate.† The crystals (*b*) remaining undissolved were also re-crystallised, the crystals obtained resembling those of aniline sulphate. The two crops of crystals were drained, dried, and the SO_4 determined.

a. 2·5690 grms. of salt gave—
2·7292 grms. $BaSO_4$=43·769 per cent SO_4.

b. 0·9698 grm. of salt gave—
0·7900 grm. $BaSO_4$=33·563 „ „

Analysis *a* corresponds with $Al_2(SO_4)_3.18H_2O$, for which theory requires 43·209 per cent SO_4, while *b* corresponds with $(C_6H_7N)_2H_2SO_4$, requiring 33·802 per cent SO_4.

7. It will be observed that all the analytical results accord tolerably closely with the theoretical percentages of SO_4 required either for aniline sulphate or aluminium sulphate, and are either less by about 3 to 5 per cent or greater by 7 per cent than that required by aniline alum. The only seemingly reasonable conclusion to which these results lead is, that aniline sulphate does not form an alum by a combination with aluminium sulphate, and consequently that in this particular no analogy exists between aniline and ammonia and the primary amines of the methyl series. Further, it does not seem probable, when considering the alums of Cr, Fe, and Mn,—the difficulties of their preparation, and their instability as compared with those of Al,—that alums could be obtained containing these metals together with aniline, but on this point no experiments have been made.

II. *Rosanilin.*

1. The results of the above experiments with aniline sulphate being purely negative, the probability that rosanilin sulphate would combine with aluminic sulphate was not thought to be very great when it was considered that rosanilin was even further removed from ammonia than aniline, being derivable from that body and toluydin by the action of oxidising agents, which transform these primary aromatic amines into a secondary triamine containing the two dyad radicles phenylen (C_6H_4″) and toluylen (C_7H_6″). Still the analogy existing between the

* For which, as well as for the pure rosanilin used in the experiments made with that base, I am indebted to the kindness of two friends.

† The animal charcoal appears to decompose the salt to some extent, a slight odour of aniline being recognisable after its addition.

* The quantity obtained was too small to allow of duplicate analyses.

† The salt contained a trace of anilins.

salts of ammonia and those of rosanilin was sufficient to induce the trial of the following experiment.

2. Over 20 grms. of rosanilin base ($C_{20}H_{19}N_3,H_2O$), nearly chemically pure, were added to the requisite quantity of hot, dilute, pure sulphuric acid, to form rosanilin sulphate [$(C_{20}H_{19}N_3)_2H_2SO_4$], and this was mixed with the quantity of commercial aluminium sulphate in concentrated solution required to form the alum. The mixed solution was evaporated, and, on cooling, crystals having the metallic green lustre separated out. The crystals were drained, dried, and analysed. Heated on platinum-foil they left a residue of alumina. Two determinations of SO_4 gave the following results :—

a. 1·0643 grms. crystals gave—
0·295 grm. $BaSO_4$ = 11·420 per cent SO_4.

b. 0·9372 grm. crystals gave—
0·254 grm. $BaSO_4$ = 11·170 ,, ,,

Mean .. .. 11·295 ,, ,,

Theory requires for $(C_{20}H_{19}N_3)_2H_2SO_4$, 13·71 per cent SO_4; and for $(C_{20}H_{19}N_3)H_2SO_4,Al_2(SO_4)_3,24H_2O$. 26·04 per cent SO_4. These results indicate that the crystals consist of rosanilin sulphate, with aluminic sulphate and probably water as impurities.

3. To ascertain if results more nearly accordant with those required by theory for rosanilin sulphate could be obtained, some of the crystals were dissolved in alcohol, filtered, re-crystallised, and dried at 100° C. The SO_4 they contained was then determined.

0·2328 grm. of crystals gave—
0·074 grm. $BaSO_4$ = 13·192 per cent SO_4.

Theory .. .. 13·710 ,, ,,

4. It is evident, therefore, that rosanilin sulphate does not combine with aluminic sulphate to form an alum, and that in this respect it is unlike ammonia and the primary amines of the methyl series, but behaves like aniline, with which it is altogether more closely allied. The remark made, in conclusion, with respect to aniline not forming alums with the sulphates of Cr, Fe, and Mn, applies to rosanilin with equal, if not greater, force.

ON AREOMETERS.*—PART II.

By P. CASAMAJOR.

(Continued from p. 268.)

Correction of the Indications of Areometers for Errors Resulting from Variations of Temperature.

IN a paper, "On the Expansion of Sugar Solutions by Heat," in *American Chemist* for June, 1874 (vol. iv., p. 447), and in *Sugar Cane* for September, 1874 (vol. vi., p. 455), I gave a detailed account of the researches I was obliged to make to ascertain the expansion of sugar solutions up to the solution containing 23 per cent of sugar. As my object was limited to solutions which can be introduced directly in the tube of the saccharometer, I did not at that time go beyond 23 per cent of sugar. The extreme temperatures were 5° and 45° Centigrade. I took a certain volume of liquid at 5°, and ascertained the total expansion from 5° to 45°, and afterwards divided this expansion by 40, the total number of degrees, and by the volume at 5° in cubic centimetres, the result being the mean expansion of 1 c.c. for every degree between these limits of temperature. The expansion of pure water was ascertained in this way, also that of sugar solutions containing 11¼ per cent and 23 per cent of sugar.

The mean relative expansion of 1 c.c. of water for every degree Centigrade between 5° and 45° was found to be 0·00021;* that of the solution containing 23 per cent of sugar was 0·00023, and the solution containing 11¼ per cent, instead of giving the average 0·00022, gave repeatedly 0·000215. As this latter number did not depart very sensibly from the average, I had a right to conclude that the intermediate numbers followed materially the same laws as the extremes.

To apply the expansion 0·00021 to the areometer which I use for testing sugar solutions, we must remember that we found for this areometer N = 260; therefore, the average expansion for an increase of 1°C. is 260 × 0·00021 = 0·0546 degree.

If we place the same areometer in a solution 23° Balling, the submerged portion is 260° − 23° = 237° Balling, and the average expansion in this case is 237 × 0·00023 = 0·0545. As we have admitted that the intermediate solutions follow materially the same laws as the extremes, we arrive at this remarkable result :—*That the mean correction for variation of temperature is the same for sugar solutions up to 23 per cent of sugar as for water.* Now, if we remember that the graduation of a Balling areometer increases downward, so that the deeper the instrument sinks the less is the degree indicated; and if we admit that the expansion from degree to degree is 0·0545°, we may see that the indication at any temperature may be restored to that corresponding to the normal by adding 0·0545 as many times to the observed indication as there are degrees between the observed temperature and the normal.

If 15° is the normal, at 16° we would have to add 0·0545°, at 17° 0·109°, at 18° 0·163°, &c. Between 12° and 27° C., to which I always brought the temperature of my solutions, the error committed by taking a uniform expansion does not exceed 0·087°.

I have, however, more recently calculated the expansion of water for every degree C. Taking 15° C. as a normal, the numbers of the following table, No. 3, were obtained by multiplying the relative expansions as given in the third column of Table No. 1 by 260. Table No. 4 is calculated by taking 17½° C. as a normal, to be used for areometers made in Germany, as these are based on 17½° C. (14° R.)

To make use of either of these tables, we place a Balling's areometer in a sugar solution, and note the degree and tenth of degree indicated, and afterwards place in the same solution a thermometer, and note the temperature. Opposite to the temperature observed we find the number to be added to the indication of the areometer, if above the normal, or to be subtracted if below.

If we take 15° C. as a normal, and the areometer gives 12·8°, while the thermometer shows 20°, the correction in Table No. 3 is 0·218, which is added to 12·8, giving 13·018.

We may, however, correct the indication of the Balling areometer in a simpler and quicker way by using a method entirely analogous to that which I gave for volumetric analysis in the paper read before this Society in December.

This consists in erecting a series of vertical equidistant lines, the space between two of which corresponds to 1° C., and intersecting these lines by a series of equidistant lines perpendicular to the first, the distances between two of which we may make equivalent to 0·01° Balling. We may then, adopting either 15° or 17½° C. as a normal, take on every vertical line a distance corresponding to the hundredths of a degree, as found in the second column of Table No. 3 or No. 4, and afterwards connect the points thus obtained by a curve. By finding the points at which this curve intersects the horizontal lines corresponding to 0·1, 0·2, &c., of a degree, and noting the temperatures at these intersections, we form Table No. 5 for 15° C. as a normal, and Table No. 6 for 17½° C. as normal. We may

* Read before the American Chemical Society May 3, 1877.

* For the sake of comparison we may add the total relative expansion from 15° to 45° (0·003312) to the total relative contraction from 15° to 5° (0·000612), as found in the third column of Table No. 1, and divide the sum 0·008924 by 40, which gives 0·00223. This number is very nearly the same as the one I found directly. If we consider the series of operations by which the numbers 0·008312 and 0·000612 were obtained, as explained in the paper read before this Society in December, the coincidence, or quasi-coincidence, is certainly satisfactory.

TABLE No. 3.—CORRECTIONS OF BALLING'S AREOMETER. (Normal Temperature 15° C.)

Degrees C.	Correction of Areometer.	Degrees C.	Correction of Areometer.	Degrees C.	Correction of Areometer.
5	0·159	19	0·169	33	1·049
6	0·161	20	0·218	34	1·128
7	0·159	21	0·269	35	1·212
8	0·153	22	0·323	36	1·297
9	0·143	23	0·380	37	1·384
10	0·127	24	0·438	38	1 473
11	0·109	25	0·506	39	1·570
12	0 086	26	0·567	40	1·659
13	0·062	27	0·631	41	1·755
14	0·032	28	0·697	42	1·854
15	normal	29	0·764	43	1·954
15	0·038	30	0·833	44	2·054
17	0·079	31	0·898	45	2·158
18	0·123	32	0·972		

TABLE No. 4.—CORRECTIONS OF BALLING'S AREOMETER. (Normal Temperature 17½° C.)

Degrees C.	Correction of Areometer.	Degrees C.	Correction of Areometer.	Degrees C.	Correction of Areometer.
5·5	0·262	19·5	0·083	33·5	0·983
6·5	0·263	20·5	0·143	34·3	1·037
7·5	0·261	21·5	0·193	35·5	1·120
8·5	0·252	22·5	0·250	36·5	1·204
9·5	0·243	23·5	0·308	37·5	1·344
10·5	0·228	24·5	0·367	38·5	1·381
11·5	0·208	25·5	0·428	39·5	1·473
12·5	0·183	26·5	0·492	40·5	1·573
13·5	0·157	27·5	0·557	41·5	1·664
14·5	0·110	28·5	0·622	42·5	1·762
15·5	0·076	29·5	0·700	43·5	1·862
16·5	0·040	30·5	0·765	44·5	1·964
17·5	normal	31·5	0·832	45·5	2·079
18·5	0·045	32·5	0·907		

notice that in Table No. 5 the correction +0·1° happens at 17½° C., so that Table No. 6 is easily obtained by subtracting 0·1 from the indications of the preceding table.

TABLE No. 5.

Degrees Centigrade.	Degree Balling to be added.
9·5	−0·15
11·8	−0·1
15·0	normal
17·5	0·1
19·7	0·2
21·6	0·3
23·4	0·4
25·2	0·5
26·7	0·6
28·2	0·7
29·5	0·8
31·0	0·9
32·5	1·0
34·0	1·1
35·0	1·2
36·4	1 3
37·7	1·4
38·8	1·5
40·0	1·6
40·7	1·7
41·8	1·8
43·0	1·9
44·0	2·0
45·0	2·1

TABLE No. 6.

Degrees Centigrade.	Degree Balling to be added.
9·5	−0·25
11·8	−0·2
15·0	−0·1
17·5	normal
19·7	0·1
21·6	0·2
23·4	0·3
25·2	0·4
26·7	0·5
28·2	0·6
29·5	0·7
31·0	0·8
32·5	0·9
34·0	1·0
35·0	1·1
36·4	1·2
37·7	1·3
38·8	1·4
40·0	1·5
40·7	1·6
41·8	1·7
43·0	1·8
44·0	1·9
45·0	2·0

We may, instead of either of these tables, use a thermometer with an ivory scale, having, on one side of the mercury column, the degrees C., and on the other side the numbers in the second column of either Table No. 5 or Table No. 6, exactly as for the thermometer which I described in detail in the paper read before this Society in December.

If, instead of the areometer giving the percentage of sugar, we wish to use one giving the specific gravities, we must remember that, in the case of water, we may use Table No. 2 by simply adding the numbers opposite to the temperatures observed to obtain the correct reading at the normal temperature. We have shown, besides, that for Balling's areometer *the correction of temperature is the same for all sugar solutions up to 23 per cent of sugar as for water.* Therefore, for any sugar solution up to sp. gr. 1·1, we have merely to add the numbers opposite to the temperatures observed, as found in Table No. 2, to restore the indication of the areometer to the specific gravity at 15° C.

If, as it is usual in Germany, we take 17½° C. as a normal, we may use the following table, No. 7:—

TABLE No. 7.

Degree Centigrade.	Quantity to add to sp. gr.	Degree Centigrade.	Quantity to add to sp. gr.
7·5	−0·001	34·7	0·004
13·0	−0·0005	36·2	0·0045
17·5	0·	37·4	0·005
20·2	0·0005	39·0	0·0055
23·0	0·001	40·5	0·006
25·0	0·0015	42·0	0·0065
27·0	0·002	43·4	0·007
29·0	0·0025	44·2	0·0075
31·0	0·003	45·0	0·008
32·5	0·0035		

As in previous cases, we may, instead of using the Tables No. 2 and No. 7, write the corrections directly on the ivory scale of a thermometer on one side of the column of mercury, opposite to the corresponding temperatures on the other side.

In describing the methods that I have given for correcting the errors in the indications of areometers in the case of sugar solutions up to the solution holding 23 p. c. of sugar, I have proved that the total correction for expansion is the same as for pure water from 5° to 45° C., but I have not afforded any proof that sugar solutions vary in expansion from degree to degree in a manner exactly parallel to the expansion of water, although I have assumed that such is the case. I can say, however, that I have the best of reasons for knowing that no appreciable error is committed by this assumption, for, by making a great number of tests of the same sugar at different temperatures and at different degrees of dilution, I have repeatedly obtained the same coefficient of purity within less than ½ p. c. As such facts have presented themselves hundreds of times in my practice, I have no hesitation in recommending the method I have given for solutions within the limits mentioned.

This conclusion is confirmed by what happens when a solution containing 11½ p. c. or 23 p. c. of sugar is placed in a dilatometer and cooled down to 5° C., and afterwards the dilatometer is placed in a water-bath kept at 45° C. The volume of the solution increases at first very slowly, but gradually the rate of increase, for equal spaces of time, becomes greater, and towards the end the increase of volume is very rapid. As the rate at which the temperature of the solution increases is proportional to the excess of the temperature of the bath over that of the contents of the dilatometer, the rate of increase of temperature is greater at first than towards the end. This circumstance renders the increase of the rate of expansion towards the end more remarkable, and shows that the law of expansion for these sugar solutions is very nearly the same as for water.

As to thicker sugar solutions, I have lately determined the expansion of the solution of specific gravity 1·192 (23·2° Beaumé), and that of the solution of specific gravity 1·3116 (34·2° Beaumé), between 5° and 45° C., which are given in the table below. To compare the corrections

to be made with areometers of even scales, in the case of these expansions, with the corrections in the case of solutions containing 23 p. c. of sugar or less, I have expressed the densities of all these solutions in Beaumé degrees, as Beaumé's areometer, in which N = 144 is commonly used for sugar solutions of all kinds, while the areometer in which N = 260 is only suitable for weak solutions, as I have already explained.

Degrees Beaumé.	Average Expansion of 1 c.c. between 5° and 45° C.	Number of Areometer Degrees Submerged.	Correction—Product of 2nd by 3rd Column.
0	0·00021	144·0	0·03024
13 (23 p. c. sugar)	0·00023	131·0	0·03013
23·2	0·000288	120·8	0·03473
34·2	0·000328	109·8	0·03601

We may see in this table that at 0° and 13° Beaumé the correction is materially the same as I have shown for the areometer in which N = 260.

In the case of thicker solutions, up to 34° Beaumé, we may also see that the corrections are represented by larger numbers, and we are naturally led to inquire whether for such solutions we may still correct the indications of areometers by using the tables I have given without incurring the risk of committing serious errors.

As the error committed would be the greatest with a solution of 34·2° Beaumé, we may find the maximum error by calculating on the base of a mean correction for every degree Centigrade = 0·03601°, and supposing that the observation is taken at 45° C. The total correction in this case is 0·03601° × 30 = 1·083°, while, if the mean correction for every degree C. is 0·0302°, the total correction is 0·0302 × 30 = 0·906; the difference, 0·177, is the maximum error we may commit by using the table I have given. For thinner solutions and for lower temperatures the error would be less.

In the case of sugar solutions having 23 p. c. of sugar or less, I have given my reasons for thinking that their laws of expansion are similar to those of pure water. I may add that solutions of density equal to 23·2° and 34·2° Beaumé show the same peculiarity in the dilatometer of greater expansion for equal spaces of time as the temperature increases.

TIN IN CANNED FOOD.

By ALBERT E. MENKE.

In opening a tin can of pine-apples, I found that at the place where the tin had been soldered corrosion had taken place, which induced me to test for tin, having found indications of it, and made a quantitative analysis with the following results:—I first poured the syrup off, and squeezed out the juice from the fruit; then oxidised with chlorate of potash and hydrochloric acid, boiled, and then reduced the tin to the stannous state with sulphite of soda; sulphuretted hydrogen was then passed through the liquid, the tin sulphide was then filtered off, dissolved in strong hydrochloric acid, largely diluted, and titrated with potassium permanganate. 0·151335 gramme of tin was found in a tin of pine-apple, which weighed 1½lbs. I next tried lobster and apples, and found in the lobster 0·010089 gramme, and in the apples 0·00672 gramme of tin, showing that the pine-apple was the worst, which would support the theory that it was due to the corrosion.

Chemical Laboratory, King's College, June 28, 1878.

Ozone.—According to M. Erémine, the decomposition of ozone in daylight is slower than in the dark, and if kept for some time after its preparation without being used, its disinfecting power is increased.—*Les Mondes.*

ON BOTTLE-GLASS.

By Dr. H. MACAGNO,
Director of Agricultural Station of Gattinara (Italy).

In the following table are indicated the results of analyses made on several samples of bottle-glass. Every bottle is named by the quality of wine it is commonly employed for keeping; the specific gravity and the chemical composition were determined by the ordinary processes; the *solubility in water* is given by the quantity of materials dissolved in 5 litres of water boiling for an hour with 100 grms. of the finely-powdered glass; the *corrosion degree* is ascertained also by boiling for an hour 100 grms. of the same powder in 5 litres of potassium bitartrate solution at 0·33 per cent, and estimating the quantity of tartaric acid neutralised. An inverted Liebig's condenser maintained the liquid volume constant in both these operations.

No. 24 contained a little manganese. In all the samples magnesia was sought, but only in Nos. 16, 17, 19, 21, 27, and 34 the quantity found could be estimated, and was included with the lime. (For Table see next page.)

These results lead to the conclusion that the chemical composition of bottle-glass is not a sufficient character for judging of its quality. The amount of alkali or lime does not indicate the resisting power of the glass to water or acids, which is the most important condition for wine keeping.

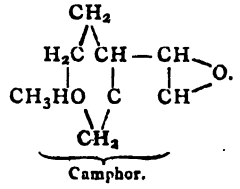
Therefore the superior quality of the French glasses is well shown by these results, while, on the contrary, the Rhine, Madeira, Malaga, and Xeres bottles seem of a very bad composition. In order of colour we must set in the first rank the deep green; in the second, the white and common green: the clear green, the red-brown, and the yellow-brown are the worst, and they must be regarded as easily dangerous to ordinary wines rich in potassium bitartrate.

PROCEEDINGS OF SOCIETIES.

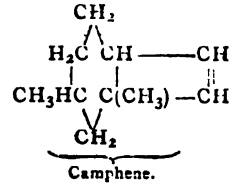
CHEMICAL SOCIETY.

Thursday, June 20, 1878.

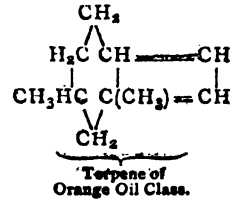
The last communication made to the meeting was by Dr. Armstrong, entitled "*Laboratory Notes.*" (1.) The author described and exhibited a simple apparatus for fractional distillation. (2.) A method for the separation of mesitylene and pseudo-cumene was described, based on the fact that the sulpho-acid of the former is decomposed much more readily than that of the latter on heating with hydrochloric acid. (3.) The author suggested new formulæ for camphor and the terpenes of the lemon oil and camphene classes, which are appended:—



Camphor.



Camphene.



Terpene of Orange Oil Class.

		Specific Gravity.	Chemical Composition per cent. Potash and Soda.	Lime.	Alumina and Iron.	Silicic Acid.	Solubility in Water.	Corrosion Degree.	Origin.
	White Glass.								
1.	Used for Rhenish	2·423	13·48	7·56	1·83	77·13	2·605	1·650	Austria.
2.	,, Bordeaux	2·429	13·22	8·89	1·75	76·14	2·450	1·275	France.
3.	,, Lunel, first quality ..	2·489	16·10	8·54	1·82	73·54	2·740	2·100	,,
4.	,, ,, second quality	2·461	18·45	6·64	1·13	73·95	2·930	2·750	,,
5.	,, Chianti	2·462	11·29	9 65	3·09	75·97	2·360	2·325	Italy.
	Mean	2·453	14·51	8·22	1·92	75·34	2·617	2·020	
	Clear Green Glass.								
6.	Used for Tokay, first quality..	2·408	13·82	7·09	4·93	74·16	2·900	3·000	Hungary.
7.	,, ,, second quality	2·484	14·58	6·40	4·00	75·00	4·460	5·775	,,
8.	,, Fellner	2·529	18·16	9·69	7·48	64·67	2·170	3·150	,,
	Mean	2·474	15·52	7·73	5·47	71·27	3·177	3·975	
	Common Green Glass.								
9.	Used for Rhenish	2·513	19·42	7·89	5·37	67·32	4·700	6·975	Austria.
10.	,, ,, ...	2·492	20·89	6·01	5·35	67·75	7·600	9·525	,,
11.	,, Bordeaux	2·559	3·75	16·06	14·27	65·92	2·550	2·550	France.
12.	,, ,, ...	2·600	10·76	15·02	13·96	60·26	1·650	1·350	,,
13.	,, ,, ...	2·577	7·94	15·09	8·79	68·18	1·450	1·500	,,
14.	,, ,, ...	2·702	3·88	23·59	16·25	56·28	1·530	1·575	Italy.
15.	,, Champagne	2·659	6·59	19·36	11·96	63·09	1·000	2·325	France.
16.	,, ,, ...	—	4·48	28·15	7·21	58·52	—	—	Italy.
17.	,, Rohitscher	2·522	15·62	11·49	8·27	64·62	1·740	2·400	Hungary.
18.	,, Xeres	2·561	9·67	11·94	15·61	62·78	1·480	1·125	Spain.
19.	,, ,, ...	2·516	17·18	11·55	6·68	64·59	2·300	2·700	,,
	Mean	2·570	10·92	15·10	10·34	63·56	2·600	3·202	
	Deep Green Glass.								
20.	Used for Bourgogne	2·674	2·86	23·36	14·92	58·86	1·270	1·275	France.
21.	,, ,, ...	—	3·91	29·81	6·15	58·32	—	—	Italy.
	Mean	2·674	3·38	26·58	10·53	58·59	1·270	1·275	
	Red-brown Glass.								
22.	Used for Rhenish	2·513	19·34	6·94	7·45	66·27	4·610	6·675	Austria.
23.	,, ,, ...	2·519	19·68	8·49	6·56	65·27	3·180	5·100	,,
24.	,, Bourgogne	2·510	17·76	11·29	5·60	65·35	3·350	3·900	France.
25.	,, Ruster	2·462	20·01	4·75	3·57	71·76	4·580	7·265	Hungary.
26.	,, Rohitscher	2·578	9·82	13·12	11·22	65·84	1·630	1·500	,,
27.	,, Rhine	—	8·04	21·08	6·91	62·21	—	—	France.
	Mean	2·516	15·77	9·28	6·88	66·15	3·470	4·888	
	Yellow-brown Glass.								
28.	Used for Bordeaux	2·629	3·82	26·25	11·17	58·76	1·370	1·500	France.
29.	,, Madeira, first quality	2·537	19·07	10·25	5·86	64·82	2·470	3·300	Spain.
30.	,, ,, second qual.	2·565	15·68	11·75	10·53	62·04	2·380	2·925	,,
31.	,, Malaga	2·519	19·11	11·51	7·96	61·42	2·660	4·125	,,
32.	,, Mosler	2·556	16·75	10·11	10·32	62·91	2·670	3·750	Croatia.
33.	,, Xeres	2·511	17·68	10·42	5·14	66·76	3·470	4·725	Spain.
34.	,, Little Champagne ..	—	10·21	20·11	5·14	63·15	—	—	Italy.
	Mean	2·553	14·62	14·35	8·02	62·84	2·504	3·387	

NOTICES OF BOOKS.

Handbook of Modern Chemistry, Inorganic and Organic, &c. By CHARLES MEYMOTT TIDY, M.B., &c., Professor of Chemistry at the London Hospital. London: J. A. Churchill. 1878.

DR. MEYMOTT TIDY'S Manual of Chemistry is the very latest contribution to chemical literature, and is in every respect one of the most complete minor treatises on the subject which has yet appeared. The author, by judicious condensation, and by the avoidance of anything approaching to verbosity or fine writing, has managed to compress an enormous amount of information, practical and theoretical, into some 730 pages. The mere collection of such a mass of details from all points of the compass must have been a colossal task, and we are bound to say that the way in which they are arranged shows that the hand of the experienced professor has been at work as well as that of the patient and careful compiler. A book like the present must of necessity be to a great extent based on those which have gone before, and it is only by the mode in which its principles and facts are classified and correlated that the author can lay claim to any originality. A striking instance of this occurs at the end of the description of the halogens and their compounds, where Dr. Tidy shows the relations of those elements to each other in a very complete manner. He first shows the student that in their origin, atomicity, action on water

and organic bodies, bleaching, oxidising, and disinfecting powers, and their metallic salts, they closely resemble each other, while in their form, colour, specific gravity, and atomic weight, as well as in many of their reactions, they exhibit a remarkable sequence of properties. We do not remember to have seen these relations so fully described in any other manual, the existence of orders, genera, and species amongst the elements being only too often slurred over.

Dr. Tidy divides his work into three sections,—the chemistry of the non-metals; the chemistry of the metals; and the chemistry of organic bodies; each element and compound being considered under six different heads,—history; natural history; preparation; sensible physical and chemical properties; uses in medicine; and the arts and tests. The author being a professor in a medical school, great prominence is very properly given to the bearing of chemistry on medicine and hygiene, the theoretical, analytical, and technological information given being in no way curtailed.

For the sake of students and teachers who have adopted Dr. Frankland's system of notation, the ordinary and constitutional formulæ of most compounds are given side by side.

Leaving the large amount of information conveyed to the student in so small a compass out of the question, the book is a model of how such a work should be arranged. It is long since we have seen a scientific manual put together in such a thoroughly workmanlike manner. It is printed on good paper in beautifully clear type, and the index, as well as the numerous tables, are particularly copious and well-arranged.

The information supplied is brought down to the very latest date, gallium and Pictet's researches on the liquefaction of gases being found in their proper places.

Dr. Tidy's work is quite worthy of ranking with the classical manuals of Miller and Fownes, and we may safely prophesy that it will speedily take its place side by side with them in all chemical libraries.

Report on Canadian Graphite, with Special Reference to its Employment as a Refractory Material. By CHRISTIAN HOFFMANN. Montreal. 1878.

THIS report forms part of those addressed to the Geological Survey of Canada, and is intended to show that the Canadian graphite is fully equal to that of Ceylon for the manufacture of plumbago crucibles and for similar purposes. Mr. Hoffmann gives us numerous comparative tables showing the specific gravity and composition of different specimens of the two graphites, which seem to show that on an average there is but little to choose between them, some of the Canadian specimens being superior in relative incombustibility and freedom from ash. Specimens from the Ticonderoga Mines, in the State of New York, were found to be much less pure than the Ceylon and Canadian qualities. Taking the relative combustibility of the best specimen of Ceylon graphite at 1·00, two specimens of the Canadian variety ranked at 0·98 and 0·99 respectively.

On the Filtration of Potable Water. By Professor W. R. NICHOLS, of the Massachusetts Institute of Technology. Boston: Rand, Avery, and Co. 1878.

THIS is a valuable report addressed by Professor Nichols to the Massachusetts State Board of Health on the different methods of filtering water for public or private purposes at present in use in Europe and America. We learn from it with some surprise that the practice of filtering water on a large scale is only just beginning to come into use in America, and this in spite of our Transatlantic brethren being confirmed water drinkers—at table at least. Poughkeepsie, a small town of some 25,000 inhabitants, on the Hudson, was the first to adopt a proper system for the artificial filtration of its water supply in 1871, but its good example seems to have been followed in only two or three instances. Certain towns and companies professed to filter their water as far back as 1853, but as the areas of the filter beds were totally inadequate, and the cleansing insufficient and infrequent, the water might just as well have been used in its natural condition. Professor Nichols gives it as his opinion that good animal charcoal is the best filtering material for household filters. At the end of the report there is a long list of works on the subject in English, French, and German.

Metals; and their Chief Industrial Applications. By CHARLES R. ALDER WRIGHT, Lecturer on Chemistry at St. Mary's Hospital Medical School. London: Macmillan and Co. 1878.

DR. ALDER WRIGHT'S little book is founded on a course of lectures delivered by him at the Royal Institution in 1877. In the opening chapter the author gives us a general sketch of the physical and chemical principles involved in the extraction of metals from their ores by volatilisation, amalgamation, smelting, liquation, and the various wet processes. The table showing the classification of the different metal extracting processes is an excellent one, and deserves reprinting in larger type for suspension in technological class-rooms. The next three chapters are devoted respectively to the metallurgy of the precious metals; of the more important industrial metals, such as iron, copper, and zinc; and of the less important base metals, such as aluminium, nickel, &c. The physical properties of metals are next treated of, the 6th chapter being given up to their thermic and electric relations, the last chapter giving an account of their chemical relations.

It will be thus seen that, as far as arrangement goes, Dr. Alder Wright has treated his subject in a methodical and logical manner. The matter, both in style and accuracy, is, generally speaking, worthy of the arrangement, although at times the author, as in the first chapter, has yielded to the temptation of going into theoretical considerations which are far above the comprehension of the reading public. The practical part of the book is particularly plain and devoid of abstruse technicalities, the chapter on the physical relations of the metals being particularly good. The information given is brought down to the latest moment, the telephone being described as illustrating the powers of magnetised steel. The work is illustrated by numerous woodcuts.

A Manual of Microscopic Mounting, with Notes on the Collection and Examination of Objects. By JOHN H. MARTIN. Second Edition. London: J. and A. Churchill. 1878.

THIS work contains a large amount of information not only on mounting objects for the microscope, but also many valuable hints on microscopic manipulation generally. The first edition of Mr. Martin's manual, which was published in 1872, has long been out of print, and he has done well to publish a second edition. The present edition has been revised (very carelessly, by the way), and several of the illustrations have been re-drawn. The analytical chemist will find a number of interesting details on micro-analysis.

Although professedly a work on mounting only, Mr. Martin might have given us a short account of micro-spectro-analysis. The misprints amongst the Latin names are very numerous, and Mr. Martin's style is often more practical than lucid. He gives us the latest formulæ for various chemical substances, but adheres to such old-fashioned names as potass, carbazotic acid, &c. The work is illustrated by nearly 150 woodcuts, many of which are very badly executed. In spite of these defects, however,

Mr. Martin's book is a very useful one. What does the author mean, by dubbing himself a "Fellow" of the "Society of Arts?"

Report on the Air of Glasgow, with Tables of Wind, Temperature, and Rainfall, for the Months of September and October, 1877. By E. M. Dixon, B.Sc., in co-operation with the Medical Officer of Health. Presented to the Committee of Health of the Magistrates and Council of Glasgow, February 25, 1878.

A systematic examination of the chemical composition of the air is made at a number of points in the city of Glasgow. At each station the air is drawn for two or three days continuously, in several distinct currents, through as many distinct solutions, each adapted to withdraw some special substance from the stream of air passing through it. Each current is afterwards measured by means of a special gas-meter, and the matter taken up in each solution is finally determined by delicate micro-chemical processes, the details of which will be given on a future occasion. The substances thus sought for have been carbonic acid, sulphur in combination, chlorine, free and combined, nitrogen as ammonia, and nitrogen as "albuminoid ammonia." The rainfall, velocity and direction of wind, and the temperature have been simultaneously recorded. The observers find that the quantity of nitrogenous matter in the air is decidedly increased during the summer months, and that the effect of a fresh breeze in purifying the air of the city is very distinct.

We quite agree with the author that such observations, to be useful, should be made continuously.

*Microscopical Examination of Water.** By Wentworth Lascelles Scott.

The author insists upon a microscopical examination of water as an adjunct to its chemical analysis, and to facilitate the former process and secure uniformity of results, he proposes to concentrate the vegetable or animal matter, suspended in water in a very small volume, by filtering it through filter papers, the centre of which is rendered impervious to water by means of a fatty composition. In this manner all the organisms may be easily collected in the small water-tight cone at the bottom of the funnel. If the paper is altogether too porous, he proposes to render it less pervious by immersion, in a "thin, structureless collodion."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 21, May 27, 1878.

Part Played by the Auxiliary Acids in Etherification, from a Thermo-Chemical Point of View.—M. Berthelot.—The author has established by chemical experiments the conditions of the formation of acetic ether, regarded as the type of the ethers of organic acids with the auxiliary concourse of hydrochloric acid. These experiments have thrown a light upon the influence of water and of the compounds which it forms with the hydracid. He now extends his inquiries not merely to the ethers, but to all the other products of the reciprocal action of the six bodies present, alcohol, water, and the hydrochloric acids and ethers.

Production and Constitution of Chromium Steels.—M. Boussingault.—The methods followed for the determination of chrome and of carbon in chromium steels and in ferro-chrome is referred to, but not given.

Transparent Hydrated Silica and Hydrophane, Obtained by the Action of Oxalic Acid upon the Alkaline Silicates.—E. Monier.—The experiment should be made upon a weight of 500 to 600 grms. silicate of soda at 35° or 40° B., whilst the oxalic acid is diluted to 4° B. If this acid is allowed to act for six months at the ordinary temperature a transparent siliceous layer is obtained of from 1 to 3 millimetres in thickness. An important precaution is to incline the vessel containing the silicate of soda at an angle of 45°, and then pour in the oxalic acid.

Certain Features Presented by the Disposition of Fire-Damp in Mines.—J. Coquillion.—The author finds that where the atmosphere is still, fire-damp mixes very slowly with air, and seems to form distinct zones.

Thermo-chemical Study of Certain Substitution-products of the Acetic and Benzoic Acids.—W. Louguinine.—This paper does not admit of useful abstraction.

Researches on Glycolide.—J. H. Norton and J. Tcherniak.—The authors adopt the following method for the preparation of glycolide. They dissolve sodium in 15 parts of absolute alcohol, and add a concentrated alcoholic solution of chloracetic acid. After standing for some hours almost the whole of the sodium chlor-acetate separates as a white precipitate. This is collected upon a funnel, drained by means of a filter-pump, and dried. It is then heated to 100° in a stove, and when perfectly dry the temperature is gradually raised to 150°. It is well to spread out the salt over large flat surfaces, stirring from time to time. After thus heating the salt for two days it is withdrawn from the stove, powdered, and taken up again with boiling water, thrown upon a filter, and washed as long as the washings are precipitated by nitrate of silver. The residue, dried at 200°, is perfectly pure glycolide.

On Trimethyl-glyceramin.—M. Hanriot.—The author obtained this compound in the form of orange-coloured tables belonging to the orthorhombic system. These crystals, though anhydrous, effloresce in a dry vacuum from the loss of hydrochloric acid. They dissolve in cold water, and more freely in hot water, and are not decomposed on boiling as much as the impure salt. They are insoluble in alcohol.

Researches on the Ammoniacal Citrates.—E. Landrin.—The author examines whether the citrate of ammonia acts merely as a solvent upon metallic oxides, or if it enters into direct combination with such oxides. The citrate of lime, insoluble in water, is soluble in ammonium citrate, and it is the solubility of this salt which hinders the precipitation of lime in Joulie's analytical process. On the other hand, magnesia, alumina, and ferric oxide form, with citric acid and ammonia, well-defined compounds, which have the general character of not precipitating phosphoric acid. Similar compounds are also formed by the oxides of manganese, nickel, cobalt, and copper.

On an Undescribed Disease of the Wines of the South of France, known as "Vins Tournés."—A. Gautier.—This malady, till a recent date, has been confounded with the "*tourne*" or "*pousse*" of the wines of the Centre. It is most severe after hot but moist autumns, when the grapes are attacked with mouldiness. The alcohol of the wines affected suffers no change, but the tannin, the colouring matter, and the tartar totally disappear. Organic and mineral acids, phenol, sulphurous acid, and especially sulphuretted hydrogen, delay but do not hinder the decomposition. The application of heat, as recommended by M. Pasteur, is also insufficient.

* Reprinted from the *Monthly Microscopical Journal* for December 1877.

On Ozonoscopic Paper.—M. Daremberg.—Ozone can neither be determined nor even qualitatively detected by means of this paper, since many substances produce an analogous reaction, whilst others prevent the reaction from being manifested even when ozone is present.

Berichte der Deutschen Chemischen Gesellschaft, No. 6., 1878.

Quinonoid Body found in a Species of Agaric.—W. Thörner.—A tinctorial substance of the composition $C_{11}H_8O_4$ has been obtained by extracting *Agaricus atratomentosus* with ether. The crystals left on the evaporation of the ether after purification form dark brown scales of a metallic lustre, soluble in boiling alcohol or glacial acetic acid, with a vineus red, and in alkalies with a greenish-yellow colour.

Researches on the Bessemer Process.—F. C. G. Müller.—It would be impossible to do justice to this important paper in the compass of an abstract.

Iodine-Derivatives of the Phenols.—H. Kämmerer and E. Benzinger.—If iodine, dissolved in potassic iodide, is added to saturation, hot, and very dilute alkaline solutions of the phenols, precipitates are obtained interesting on account of their insolubility in water and their characteristic colouration. Phenol itself gives a red precipitate, thymol one of a faint violet colour, and commercial creosote at first a greenish-brown fluorescent solution and finally a voluminous dirty-brown precipitate. The authors have made a special examination of the products of the reaction of phenol and iodine.

On Atmospheric Hydrogen Peroxide.—Em. Schöne.—(Third communication.)—An examination of the annual and diurnal periods of the hydrogen peroxide present as vapour in the air. The amount found in 1 litre of dew or hoar-frost is greater in summer than in winter. The air in houses has also been examined. In a lecture-hall which had not been used for four weeks, during which time the windows had been kept closed, there was found on July 21st, 1874, from 7.30 a.m. to 7.30 p.m., an average of 0·17 c.c. hydrogen peroxide in 1000 cubic metres of air.

On Certain Derivatives of Thymol.—L. Barth.—Four acids are obtained by the action of melting potassa upon thymol. Two of them are well known, oxybenzoïc acid and oxyterephthalic acid. The third, thymol-oxycuminic acid, has the composition $C_{10}H_{12}O_3$, and crystallises in fine, colourless, brittle needles, sparingly soluble. The fourth, thymolic acid, $C_{10}H_{10}O_5$, is readily soluble in water, and precipitable by sugar of lead from this solution. It yields an intense red colouration with ferric chloride, and appears to be bibasic.

Action of Sulphuryl Chloride upon Acetic Ether.—F. Allihn.—On cautiously adding acetic ether to sulphuryl chloride, large quantities of sulphurous and hydrochloric acids escaped, and a yellowish liquid was obtained, which, when freed from acids, distilled over between 205° and 208°, and agreed with Conrad's di-chloracetic ether. By using only one molecule sulphuryl chloride to one of acetic ether, a mono-chloracetic ether was obtained.

Oxytoluylic and Oxyphthalic Acids.—Oscar Jacobsen.—(Second communication.)—Ten oxytoluylic acids are theoretically possible, of which, after rejection of Fittica's acid and acceptation of that obtained by the author from orthoxylenol, seven are known.

Formation of Xanthoid Substances from Albumen by the Pancreatic Digestion.—G. Salomon.—By the action of the pancreatic ferment upon pure blood-fibrin, it is possible to obtain hypoxanthin, and probably also xanthin.

Atomic Weight of Glucinum.—Lothar Meyer.—The author criticises the results of MM. Nilson and Pettersson, contained in the last issue of the *Berichte*. He remarks that an element of the atomic weight $G''' = 13·8$, would find its place between $C = 11·97$, and $N = 14·01$ in the systematic classification of the elements developed by Mendelejeff and himself,* where a trivalent, metallic, or semi metallic and moderately infusible element would not suit. It is, therefore, highly probable if glucinum is really trivalent, that its equivalent weight, as determined by Awdejew, is too high (4·6 glucinum, equivalent to 1 hydrogen), and that its atomic weight is not $3 \times 4·6 = 13·8$, but must be below that of carbon and above that of boron, or between 11 and 11·5. With this atomic weight it would form the first member of the aluminium group, with a regular difference of 16 units from the second member ($Al = 27·3$). Boron, hitherto placed along with aluminium, would form the initial member of a separate group, so that in future we should have to admit between that of the alkaline earths and that of nitrogen, not two, but three groups—those of boron, of glucinum, and of carbon. The three elements, cerium, lanthanum, and didymium, with the respective atomic weights 137, 139, and 144, would rank as higher members of these three series.

New Mode of Formation of *a*-Oxy-isophthalic Acid.—Malvern W. Iles and Ira Remsen.—Sulphamin-isophthalic acid is converted into oxy-isophthalic acid by fusion with potassa. Several of its salts are described.

Synthesis of Oxindol.—A. Baeyer.—Phenyl-acetic acid, is treated in the water-bath with fuming nitric acid; the resulting mixture, after the expulsion of the nitric acid, is reduced with tin and hydrochloric acid, and the liquid is concentrated after the tin has been precipitated with sulphuretted hydrogen. The acid liquid is neutralised with carbonate of lime, and boiled for a short time with precipitated carbonate of baryta. The isomeric amido acids form salts of barium, which the ortho-acid does not, as it remains in solution. Ether extracts it at once in a pure state, when it may be recogniaed as oxindol.

Isatin and its Derivatives.—W. Suida.—An examination of acetyl-isatin, and acetyl-isatinic acid.

Electrolysis with the Liberation of Hydrogen at both Poles.—E. Elsässer.—The author observed this phenomenon in 1876 without being aware that it had been described ten years previously by Prof. Beetz. He maintains that the proportion of the volumes of hydrogen is independent of the strength of the current, and to a certain extent of the concentration of the saline solutions employed.

Aldehydines: a New Class of Bases.—A. Ladenburg.—The author applies this name to bodies formed from one molecule of an orthodiamin, and two molecules of aldehyds, with the removal of two molecules of water.

Experimental Method for the Recognition of Orthodiamines as Distinguished from their Isomers. A. Ladenburg.—The hydrochlorate of an orthodiamin, if mixed with a few drops of the oil of bitter almonds, and heated for a few minutes to 100°—120°, evolves hydrochloric acid. This is not the case with the meta- and paraloric diamines.

Action of *a*-Dinitro-chlorobenzol upon Ureas, Azo-compounds, Aromatic Hydrocarbons and Sodium-Amalgam. — C. Willgerodt. — Not suited for abstraction.

Notice of a New Mineral Spring at the Foot of the Kaselburg, near Pelm, in the Kyll-Valley.—H. Vohl.—The results of a qualitative analysis.

Colouration of the Shells of Birds' Eggs. — C. Liebermann.—An interesting paper, not suitable for abstraction. The colours in question are closely connected with biliary pigments.

On Rosanilin.—E. and O. Fischer.—The authors had based their constitutional formula for para-rosanilin upon the existence and formation of Hemilian's diphenyl-

* See *Moderne Theorie der Chemie*, 3rd Edition, p. 290.

phenylen-methan. They now admit that his results are to some extent doubtful.

The Expansion of the Fixed Elements as a Function of their Atomic Weights.—H. W. Wiebe.—The absolute expansion of the atoms appears as a periodic function of the atomic weight.

The Ethylic Derivatives of Phenl-hydrazin.—W. Ehrhardt and E. Fischer.—The authors have succeeded in separating some of the volatile bases formed on treating phenyl-hydrazin with bromethyl.

Action of Nitrous Acid upon Benzol Sulphinic Acid.—W. Koenigs.—Nitrous acid acts upon the sulphin acids, even in the cold. The author has obtained two bodies, which, both in their composition and their origin, resemble the hydroxy-azo-disulphate of potassa, and the oxy-azo-trisulphate of potassa of Fremy and Claus.

Action of Halogens upon the Salts of Guaninin.—Iwan Kamenski.—The author has examined the action of bromine and of iodurettted hydriodic acid upon guanidin carbonate. The latter reaction produced a body of the composition CN_3H_5HI+I.

Conversion of Acetyl Cyanide into its Appertaining Ketonic Acid, $C_3H_4O_3$.—*L.* Claisen and J. Shadwell.—If cyan-acetyl, well cooled, is mixed with concentrated hydrochloric acid, the mixture congeals to a crystalline mass. The body thus obtained contains the elements of cyan-acetyl plus water, and if heated for a short time with dilute hydrochloric acid, it is resolved into sal-ammoniac and the acid in question.

Transformation of the Spectra of Different Colouring Matters.—H. W. Vogel.—It is well known that the absorption-bands of one and the same substance, if dissolved in various solvents, have not always the same position. Kundt proposed the law that the absorption-bands lie the farther towards the red the greater the refractive power of the solvent, and this law holds good in many cases. On the other hand, examples are known where, on change of the solvent, the bands move neither towards the red nor the violet, but the whole character of the spectrum is modified without any chemical action of the solvent upon the dissolved body. After mentioning the modification in the absorption spectrum of purpurin accordingly as dissolved in alcohol or water, and of brasilin and hæmatoxylin in ethereal or aqueous solution, the author gives an account of his recent researches on the spectra of napthalin red in alcohol, in water, in the solid state, and on paper.

On Meta-diamido-benzol as a Reagent for Nitrous Acid.—P. Griess.—The author had previously recommended diamido-benzol as a reagent for nitrous acid, capable of indicating its presence even when diluted to the extent of 1 part in five millions. He now finds that meta-diamido-benzol, which is more easily procured, is a still better reagent, showing nitrous acid even in 10 million parts of water.

Determinations of Nitrous Acid.—C. Preusse and F. Tiemann.—The authors having examined the above-mentioned method of P. Griess, find that it is practicable in case of dilute solutions. Stronger solutions must be diluted with water free from nitrous acid, just as is required in the application of Neseler's test to ammoniacal solutions. The requisites for the process are: a dilute solution of meta-phenylen-diamin, prepared by diluting 5 grms. of this base in 1 litre of water, and slightly supersaturating with dilute sulphuric acid. A dilute sulphuric acid formed by mixing 1 vol. pure sulphuric acid with 2 vols. distilled water. A solution of alkaline nitrite, 1 c.c. of which contains 0·01 m.gr. N_2O_3. To prepare this 0·406 grm. pure, dry silver nitrite are dissolved in hot water, and converted into sodium nitrite by the addition of pure sodium chloride. When cold, the solution is made up to 1 litre, let stand till the silver chloride is perfectly precipitated, and 100 c.c. of the clear liquid are again diluted to 1 litre. After a careful examination of this and of other processes, the authors conclude that, in all waters which cannot be perfectly decolourised, the method with zinc iodide and starch is preferable, after the absence of iron compounds has been ascertained.

Methyl Derivatives of α-Naphthylamin.—Ludwig Landshoff.—Not capable of useful abstraction.

Derivatives of Caffeic Acid and Hydro-caffeic Acid, and Synthesis of Caffeic Acid.—F. Tiemann and Nagajosi Nagai.—The diacetyl derivatives of caffeic acid can be prepared from protocatechuic-aldehyd by means of sodium acetate with anhydrous acetic acid.

Diacetalpha-homo-protocatechuic Acid. — Nagajosi Nagai.—The author gives an account of the preparation of this compound.

Members of the Catechuic Series.—F. Tiemann.—This lengthy paper is incapable of abstraction.

Bulletin de la Societe Chimique de Paris,
No. 9, May 5, 1878.

On the Equivalent of Gallium.—M. Lecoq de Boisbaudran.—Already noticed.

Presence of the Ferment of Urea in the Air.—M. Pierre Miquel.—A very lengthy paper, incapable of useful abstraction.

Note on Certain Derivatives of Glycerine.—M. Hanriot.—Already noticed.

Researches on Anthraflavon and Anthraflavic Acid.—M. A. Rosenstiehl.—In the introductory portion of this memoir, the author gives a history of previous investigations on the subject, and quotes from his own earlier papers. He then enters upon a comparison of oxy-anthraflavon α with isopurpurin, which he considers as identical.

Nitrated Naphthyl-sulphurous Acid δ and its Derivatives.—M. P. T. Cleve.—A description of the potassium, ammonium, silver, barium, and lead salts of the acid, its ethylic ether, amide, &c., and the behaviour of phosphorus pentachloride with the chloride of the nitrated acid.

Double Cyanides of Gold.—M. C. G. Lindbom.—An elaborate account of the formation, properties, and composition of twenty-nine compound cyanides of gold.

Amido-suphonic Acid. — M. E. Berglund. — The author prepares this acid by decomposing the basic barium salt of imido-sulphonic acid, or the mercurio-barytic salt, $HgN_2(SO_3)_4Ba_2$, by dilute sulphuric acid. It is most easily isolated by the action of sulphuretted hydrogen upon its silver salt. A considerable number of its salts are described.

Silvering glass.—M. R. Böttger.—Tartrate of silver in very fine powder is suspended in distilled water, and very dilute ammonia is then very carefully added until the tartrate of silver is dissolved. The operator must satisfy himself that a small excess of the silver-salt remains undissolved, and that the liquid gives off no ammoniacal odour. Into this bath the objects to be silvered are plunged, having been first carefully cleaned. In about ten minutes they are covered with a uniform layer of silver.—*Deutsche Industrie Zeitung.*

Purification of Honey by Dialysis.—M. E. Dietrich. —About half the weight of the honey passes through the parchment paper. The residue contained numerous mucilaginous flocks of a faint taste.

Simultaneous Action of Potassium Ferricyanide, and of Certain Acetates upon Indigo. — M. Alb. Scheurer.—Indigo exposed to the oxidising action of a mixture of caustic soda, and of potassium ferricyanide, is at once destroyed. The same reaction is obtained on steaming a vat-blue tissue, upon which has been printed a mixture of ferricyanide, mixed with any acetate what-

soever. Among the acetates, that of lime is the most efficacious. Potassium ferricyanide printed upon a medium blue, along with ammonic sulphate, destroys the indigo, and gives rise to prussian blue, which, on passage through weak soda, disappears, and gives place to white. Bichromate of potassa, in presence of a metallic sulphate or chloride, and under the influence of steam at 100°, destroys indigo, with the simultaneous production of chromic oxide, chromate of chrome, and chromate of the metal employed.

Chemiker Zeitung.
No. 20, May 16, 1878.

Magnesite is proposed in place of chalk as a material for the evolution of carbonic acid in soda-water manufactories. The residue is to be employed in the manufacture of magnesium sulphate.

A German professional association of analytical chemists is in course of formation. A rule is proposed for the special exclusion of such as make a trade of giving certificates.

No. 21, May 23, 1878.

Improvement in the Determination of Potassa in Chloride of Potassium and in Stassfurt Salts.—The determination of potassa by platinum chloride is the more inaccurate the more foreign salts, such as chloride of sodium, are present. The result obtained is generally too high, since the platino-sodic chloride, if it has become too dry, can no longer be entirely removed by washing with alcohol. Ulex avoids this error by the addition of a little glycerin, which prevents the saline solution from becoming too dry, and materially abridges the washing process.—*Zeitsch. für Anal. Chemie*, xvii., 175.

Dissolution of Ignited Ferric Oxide.—Instead of melting insoluble ferric oxide with sodic bisulphate, A. Classen prefers to boil it with dilute caustic potassa. As soon as the previously pulverulent mass becomes flocculent, the alkaline liquid is decanted off, and the oxide dissolved in concentrated hydrochloric acid.—*Zeitschrift für Anal. Chemie*, xvii., 182.

Rapid Determination of Antimony.—The ore is melted with carbonates of soda and potash and with sulphur; the filtrate from the hot aqueous extract is decomposed with hydrochloric acid, and the precipitate of antimony sulphide is converted into the antimoniate of antimonic oxide.—*Zeitschr. für Anal. Chemie*, xvii., 185.

Working of Glover's Tower.—Vorster having previously maintained that a great part of the oxides of nitrogen are reduced to free nitrogen in the working of the tower is declared by Dr. Lunge to be in error. F. Hurter confirms the statements of Vorster. — *Dingler's Polytech. Journal*, ccxxvii., 465 and 563.

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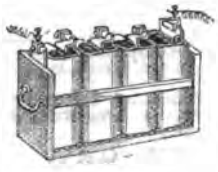

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 972.

CONTRIBUTIONS TO BLOWPIPE CHEMISTRY.

By P. CASAMAJOR.

II. Blowpipe Lamp and Candle.*

Blowpipe Lamp.—The oil lamp most generally used in blowpipe analysis is of a pattern first proposed by Berzelius. The body of this lamp is low and narrow, but its length is quite disproportionate to its other dimensions. This length is nearly 5 inches, while the other dimensions are not quite an inch each way. The foot of this lamp is formed of two cross pieces which come apart when the lamp is dismounted, the length of each piece being about 7 inches. The excessive length of this lamp, and of the cross pieces of its foot, were not objectionable if we consider the plan adopted by Berzelius for carrying his blowpipe instrument when travelling.

These were packed in a surgeon's pouch, made of a piece of leather about 40 inches long and 18 inches wide, lined with another piece of the same length, and 10 inches wide. Over these two thicknesses was a third piece 6 inches wide, stitched in several places, so as to make from twenty-five to thirty sheaths for holding the instruments. As the widest piece of leather projected about 4½ inches on each side of the 10 inch lining, the extra width was folded over, and the edges were tied together with strings. Each sheath was made by placing the six inch leather over each instrument and stitching it down, so that every instrument fitted exactly in its sheath. This pouch, when rolled up, allowed all the instruments to be carried in safety in the smallest possible compass.

For this manner of carrying instruments they require to be flat and narrow, although they may be quite long. This accounts not only for the elongated shape of the oil lamp, but also for that of alcohol lamp, the anvil and the reagent box adopted by Berzelius.

The blowpipe oil lamp, which I now present you is not adapted for being packed in a leather pouch, like the one before mentioned. I have endeavoured to obtain the minimum of volume combined with every advantage which is found in the lamp of Berzelius.

The lamp is cylindrical and quite flat. In the one we have here the height of the cylindrical portion is 1 inch, and the diameter 3 inches. The top is curved and provided with two openings closed with screw caps. One of the openings is for the wick, and the other is to fill the lamp without disturbing the wick.

The lamp is held in a covered box, as shown in figure 1. When the lamp is to be used, it is taken out of its box, which then serves as a foot. By drawing the cover out, more or less, the lamp may be raised or lowered to suit the convenience of the operator. The lamp on its foot is shown in figure 2.

To make the lamp as low as possible when put away in its box, the wick is lowered down in the lamp, as shown in figure 3. When the lamp is to be used, the wick is pulled up again. This is done by soldering the tube that carries the wick in a cylinder surmounted by a cap. This cylinder fits loosely in the larger tubulure of the lamp, and is provided with four long slits in which enter four pins attached to this tubulure. When the wick is to be lowered it is turned around until the four slits come opposite the four pins, and the wick tube is pressed down. Besides the four slits, the cylinder attached to the wick tube has four notches into which the same pins enter when the wick tube is raised and turned around an eighth of the circumference. Figure 3 shows the wick lowered down, and figure 4 shows it raised. In figure 3 may be seen one of the slits and two of the notches spoken of, and in figure 4 are two slits and one notch midway between the slits.

For the convenience of heating small dishes or crucibles

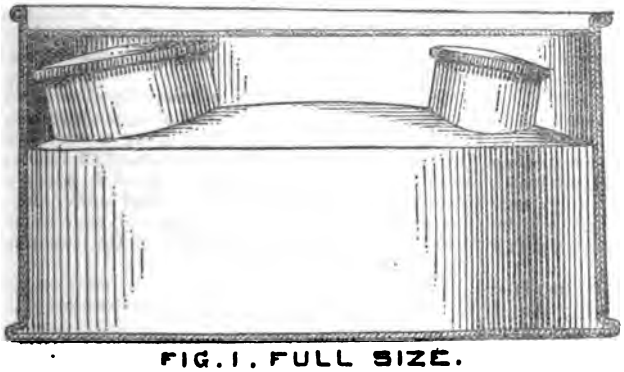


FIG. 1. FULL SIZE.

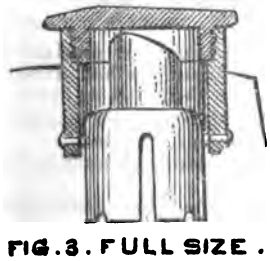


FIG. 3. FULL SIZE.

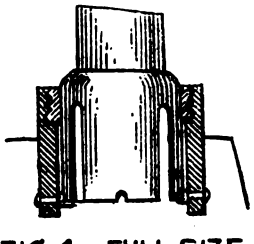


FIG. 4. FULL SIZE.

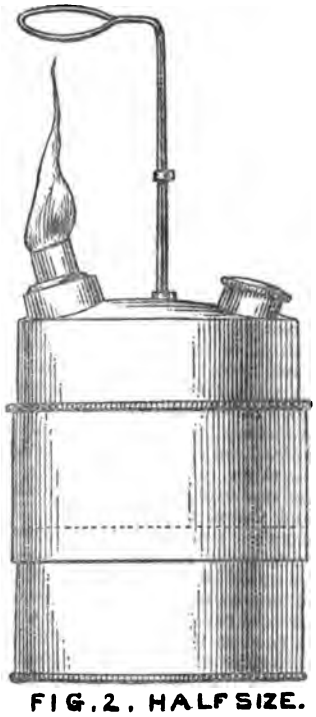


FIG. 2. HALF SIZE.

* Read before the American Chemical Society, May 2, 1878.

over the flame, a ring is placed over it, as shown in figure 2. This ring is made of brass wire, which, after being curved round in a circle, is prolonged outwards in the direction of the diameter, and finally curved downwards at right angles. This last portion of the wire is about three-quarters of an inch long, and enters in a vertical tube *a*. The tube *a* enters in another vertical tube *b*, which, in its turn, enters another tube which goes through the lamp, and is soldered to its top and bottom. The tube *a* enters very freely in the tube *b*, and this latter tube enters with equal ease in the tube soldered to the lamp. Each one of the tubes, *a* and *b*, is provided with an appendix made of spring brass, which fits so tightly round the tube that, although it may be moved up and down, it will remain in any position in which it is placed. This appendix, in each tube, rests on the top of the larger tube below it,* so that by moving either or both up and down, the ring over the flame may be raised or lowered. When the lamp is packed in its box, the tubes *a* and *b* are placed in the space between the top of the lamp and the top of the box (see figure 1). The ring is also placed in the same space, and its shank, which is made to enter the tube *a*, is then placed in the tube that goes round the lamp.

The application of a tube, soldered to the top and bottom of the lamp is equally feasible with the oil lamp of Berzelius. In this lamp, as now used, a tube placed at one of the ends slides up and down a vertical rod. By placing the tube in the middle of the lamp, the cross-pieces of the foot need be no longer than the lamp itself, the reduced length insuring greater stability than can now be obtained with the cross pieces seven inches long. By the use of a foot whose pieces are no longer than the lamp, and vertical rods, analogous to those I have described, the portability of the Berzelius lamp could be very much improved.

The box in which the lamp is packed, besides serving as an adjustable stand, answers the useful purpose of a covering to prevent the lamp from soiling things that might otherwise come in contact with it, as, with the best care and tightest joints, it is impossible to prevent a little oil from leaking out.

The best oil to use is olive oil, which should be of the best quality, as even the best is not any too good. I have lately added to olive oil one-fifth its volume of kerosene oil (refined petroleum), which makes the oil rise more freely in the wick and prevents incrustations, without making the flame perceptibly more smoky.

Blowpipe Candle.—The older Swedish chemists of pre-Berzelian times, to whom belongs the honour of laying the foundations of blowpipe chemistry, Cronsted, Bergman, and Gahn, used candles for fuel. Gahn used a triple candle, formed of three small candles in one candlestick, so as to obtain a more powerful flame. He also tried an oil lamp, with which he became disgusted, as it had no provison to prevent a leakage of oil.†

Stearic acid candles give a flame which is, to say the least, as good as that given by the best olive oil. The material itself is less costly than good olive oil, and there is no question that, for travelling, stearic acid candles are infinitely more convenient than oil.

Candles, however, present a serious objection. The heat of the blowpipe flame melts a candle in the part immediately under the flame more rapidly than in any other part, so that the melted material runs all down that side, and the wick gets very little of it.

I have tried several means of preventing this, but only lately have I found a practical way of overcoming the difficulty. This consists in wrapping a sheet of tin-foil, about as thick as fine writing paper, round the candle. The sheet of tin-foil should be of the same length as the candle, and its width should be at least one inch more than the circumference of the candle. The tin-foil is put over the candle, and its two edges are brought together, so that when the tin-foil is pressed tightly against the candle, there remain two thicknesses of foil about half an inch wide. These two thicknesses are folded over so as to present a projection of four thicknesses a quarter of an inch wide. This is again folded over so as to present eight thicknesses in a projection of one-eighth of an inch, which is finally flattened down on the candle.

When a candle, dressed in tin-foil in this manner, is burnt, the melted material remains in the tin-foil, and no amount of blowing will make it run. If the candle is allowed to burn down, the tin-foil will melt as soon as it rises high enough to come opposite the hot part of the flame, but there will always remain a cup of melted stearic acid to feed the wick.

When a candle dressed in tin-foil is used, the operator can keep the tin-foil at a convenient height with very little trouble. If the blowpipe flame is directed against the envelope, the tin melts down immediately to the level of the melted stearic acid. With a pair of scissors, the tin-foil can also be kept down to the proper height with very little trouble. A very ready way to keep it at the proper height is to poke it away outwards and downwards with the butt end of the blowpipe. It is of the greatest importance that the tin-foil wrapper should be perfectly free from holes, as the stearic acid, which is kept melted at quite a depth, will all run out when it finds an outlet. If a hole is discovered in the tin-foil, the readiest remedy is to place over it another sheet of the same foil about half an inch wide, and press this tightly round the candle in the same manner as the first covering.

By taking two candles and shaving off one side of each, and pressing the two flattened portions together, we may obtain a double candle which gives a very large flame. The two wicks should be about one-half inch apart. If the two candles are wrapped in tin-foil, taking care that the case thus formed be prolonged under the candles, the portion of stearic acid shaved off may be melted and poured in the mould of tin-foil and the two candles will be cemented into one.

* The difference of diameter between the larger tube *b* and the tube *a* that enters in it, is not properly shown in fig. 2.

† Berzelius, "Use of the Blowpipe in Chemical Analysis and Mineralogical Determinations."

PHOSPHORUS IN CLEVELAND IRONSTONE AND IN IRON.*

By J. E. STEAD.

The paper I now lay before you consists essentially of investigations made during the last three years, which may be described under the following heads, viz.:—

1st. The compound or compounds in which phosphoric acid exists in the Cleveland ironstone.

2nd. Method of eliminating phosphoric acid from iron ores.

3rd. The compounds in which phosphorus exists in Cleveland metal.

4th. The effect, physically and chemically considered, which phosphorus has on pig metal.

5th. Methods of removing it from pig iron.

6th. Phosphorus in bar iron.

The field is rather a comprehensive one, and, in order not to take up too much of your time, I shall endeavour to condense the matter into as few words as possible.

In 1781, Mayer published the results of investigations he had made, relating to a white calx which precipitated from a solution of metal in sulphuric acid. The metal was obtained from bog iron ore.

This calx, on smelting with charcoal in a crucible, yielded a very brittle and fusible button. Mayer believed it was a new element, and gave it the name Siderium.

* A Paper read before the Cleveland Institution of Engineers.

Bergmann shortly after came to the same conclusion, and also gave the metal the name Siderium.

Both of these investigators soon after this discovered that the calx was a phosphate of iron, and that the metal obtained from it was nothing more than a combination of phosphorus and iron, or phosphide of iron.

In 1806, Vauquelin in France clearly proved that phosphorus was always present in metal produced from ores containing phosphoric acid, and that it was reduced together with the iron oxides in the smelting process.

We have, since the investigations of these eminent chemists, had abundant evidence of the correctness of their conclusions, and our sincere desire is, that we may be able to supplement the discoveries they have made with one which would enable us practically, and at a small cost, to remove the phosphorus from the ore before being smelted, or from the metal containing it.

We now turn your attention to the composition of the Cleveland ironstone. The analyses below will give a general idea of the proportions present in the various constituents of the main Cleveland ironstone bed.

A separate analysis of each foot of stone through the entire section is given.

CLEVELAND IRONSTONE.

Stone Analysed.		Iron.	Silicious Matter.	Phosphoric Acid.	Moisture.	Loss by Calcination.	Iron in the Calcined stone.
Main—		P.c.	Pc.	P.c.	P.c.	P.c.	P.c.
9 feet	1st foot	26·53	18·30	1·46	8·50	27·39	36·50
	2nd ,,	29·54	10·90	1·13	9·10	29·80	42·08
	3rd ,,	29·14	10·68	1·13	9·50	29·80	41·50
	4th ,,	28·41	11·98	1·41	9·80	28·80	39·92
	5th ,,	29·97	9·00	1·17	10·00	30·83	43·31
	6th ,,	30·42	8·82	0·89	10·00	31·51	44·40
	7th ,,	29·70	9·00	0·80	10·10	31·78	43·53
	8th ,,	29·85	9·29	0·91	9·80	30·90	43·20
	9th ,,	30·30	12·01	1·16	9·00	28·50	42·40
Black Hard—							
21 in.	7 inches	30·56	12·90	0·44	8·50	26·80	41·75
	7 ,,	27·87	22·20	1·12	5·50	18·00	34·00
	7 ,,	27·26	24·70	0·81	5·00	17·00	32·85

It will be seen from these analyses that no part of the stone is free from phosphoric acid. Near the top it is highest, and in the most porous part, about 3ft. above the "Black Hard" bed, it is very much lower.

In the "Black Hard" bed I found this substance very variable in quantity, reaching as much as 3 per cent in some cases, and only 0·25 per cent in others.

1st. The compound or compounds in which phosphoric acid exists in Cleveland ironstone.

Several years ago, Mr. John Pattinson investigated this matter, and concluded, judging from the non-action of ammonium sulphide on the stone, or rather on the compound containing phosphoric acid in the stone, that no iron phosphate was present, and that the phosphoric acid must be in combination with lime. Ammonium sulphide readily decomposes, iron phosphate rendering the phosphoric acid soluble; whereas lime phosphate is not affected. I have since that time, from the results obtained by other methods of investigation, arrived at the same conclusion.

Sulphurous acid dissolves phosphate of lime much more readily than iron phosphate after they have been well calcined, and as it was found that the phosphatic compound, existing in the finely powdered calcined stone, was very readily removed by sulphurous acid, it was thought therefore that iron phosphate could not be present.

Again, when common salt is fused with iron phosphate, part of the chlorine combines with the iron, forming ferric chloride, and the sodium with the phosphoric acid, producing sodium phosphate, which is soluble in water. Lime phosphate, however, is not so decomposed, and no sodium phosphate is produced. If, therefore, calcined Cleveland stone be fused with salt, and no sodium phosphate be produced, we should have strong grounds for believing that the compound of phosphorus existed as lime phosphate, and that iron phosphate was absent. Two experiments clearly proved this to be the result, from which fact, together with the results obtained by the other methods, we may consider all the phosphoric acid in the Cleveland stone to be in combination with lime.

It is the prevailing opinion that the remains of small phosphatic animals is the source of all the phosphorus in the ironstone. I am, however, inclined to regard this theory with distrust. First, because in some parts of the "Black Hard" bed, where no fossil remains could be detected, the phosphoric acid has been found in large quantity. Secondly, because in all cases, on analysis, the shells and fossil remains, which were taken out of the stone, were proved to contain much less phosphoric acid than the surrounding ironstone.

The following analyses of fossil wood taken from various mines in this district, I think will throw some light upon this very obscure subject.

FOSSILISED WOOD FOUND IN CLEVELAND IRONSTONE.

No. I.

Lime	27·60	per cent
Phosphoric acid	20·80	,,
Magnesia	1·12	,,
Protoxide of iron	10·02	,,
Iron	5·20	,,
Cobalt and nickel	1·65	,,
Oxides of cobalt and nickel	3·70	,,
Alumina	8·25	,,
Protoxide of manganese	trace	,,
Sulphur	7·56	,,
Sulphuric acid	0·60	,,
Carbonic acid	0·75	,,
Silica	0·50	,,
Carbonaceous matter	9·60	,,
Water	3·00	,,
	100·35	,,
Lime Phosphate	45·41	,,

Several other samples gave similar results on analysis, phosphate of lime being present in large quantities in every case, as will be seen by the following analyses, viz.:—

	No. II.	No. III.	No. IV.	
Phosphate of lime	16·0	23·1	27·8	per cent.

There can be no doubt about the fact that these samples were at one time parts of trees, which in their natural state would not contain more than very minute quantities of phosphoric acid; and knowing this, we ask the question: "How can this phosphate of lime have got there?" The only answer compatible with the circumstances of the case we can offer is this, that it has been in solution, and in this state passed into the substance of the wood, and been there deposited in the condition in which we find it.

Phosphate of lime is soluble in carbonic acid. It is therefore probable, considering that this acid is a solvent, or being the principal one after water which nature possesses, that the phosphate we find in the wood has at one time been dissolved in carbonic acid. I do not mean to argue from this that all the phosphate of lime in Cleveland stone has been deposited from solution in this manner, for it is quite possible that a solution of a portion of the phosphate, before deposited in some other way, has been effected, and this been re-deposited in the woody fibre.

This subject is of extreme interest to us all. As, however, our information respecting the formation of the Cleveland ironstone is not of the clearest nature, we

should not further at present discuss the matter, leaving it rather for more complete investigation in the future.

Methods of Removing Phosphoric Acid from Ores.

The first which demands our attention is the sulphurous acid method of Jacobi, which may briefly be described as follows, viz. :—

The porous ores are placed in large tanks, and there treated with sulphurous acid, produced by burning sulphur pyrites, and condensing the acid fumes in coke tower condensers. The phosphatic compound is by this treatment dissolved out of the ore.

After the action is completed, about 90 per cent of the phosphorus is found in solution, and is run out of the tanks in the liquor. The excess of the sulphurous acid is recovered, together with the phosphate, by simply boiling the solution. The sulphurous acid, passing off as gas, is condensed in the coke towers, and the phosphate, having in this way removed from it that which rendered it soluble, is precipitated in the insoluble state, after which it is dried and sold for manure. It is stated that the price obtained for this substance covers the expense of extracting it.

In order to ascertain if Cleveland stone could be so purified, several samples of the finely powdered calcined stone were treated with thirty times their weight of sulphurous acid, containing 10 per cent of the gas. After exposure to the action for about 24 hours, the ore was separated by filtration, and the solutions examined for phosphoric acid. The following were the results obtained, viz. :—

	Phosphoric acid in stone. Per cent.	Phosphoric acid removed. Per cent.	Phosphoric acid remaining. Per cent.
1st Sample	1·73	1·64	0·09
2nd ,,	1·80	1·71	0·09
3rd ,,	1·34	1·16	0·18
4th ,,	1·14	0·97	0·17

Average amount removed = 90 per cent.

The next point was to ascertain if similar results could be obtained if lumps of stone were used instead of powdered, and for this end a small lump not more than a cubic inch was treated with large excess of acid. After three days' exposure only about 15 per cent of the phosphorus was removed, and it was only after the ore had been in contact with stronger acid for about ten days that 90 per cent was dissolved out. Larger pieces required a much longer period for purification; so long, in fact, that it induced me to conclude that the solution of the phosphorus, from such lumps as we require for our furnaces, by this method is far from being a practical solution of the difficulty.

The next method for our consideration is that of Forbes, based on the action of common salt when fused upon iron phosphate.

The porous ore is first saturated with a strong solution of salt, the water afterwards removed by heat, and the ore containing salt throughout its entire mass subjected to calcination.

By this process it is stated that the phosphoric acid is rendered soluble in water, and that the ore only requires to be washed to free it from that objectionable substance.

Experiment.—Cleveland calcined stone in fine powder was fused for about an hour with pure salt or chloride of sodium, but no phosphoric acid was made soluble by the treatment. From what has been already stated we cannot wonder at this, for it is phosphate of lime we have to deal with, and not phosphate of iron, the former of which is not acted upon or changed by fusion with salt; this method also may be considered of no value to Cleveland.

The last method to which we turn your attention is that based on the action of carbonate of soda on phosphate of lime, when fused with it. It is well known that when these compounds are fused together carbonate of lime and phosphate of soda are produced, and that, by treating the fused mass with water the phosphate of soda can be dissolved out. If, therefore, a sufficient quantity of carbonate of soda could be introduced into the lumps of ore by means of a saturated solution of the carbonate, we might be able by calcination to effect the above mentioned changes. An experiment made to test this proved that the quantity so introduced is insufficient, for only a trace of phosphorus was found to be removed after washing the stone.

Judging from the results of these experiments, we may conclude that Cleveland ironstone can not be freed from phosphorus by any methods as yet proposed.

We now turn to the smelting of ironstone.

When we know that phosphate of lime, heated with carbon and oxides, or metallic iron, to a very high temperature, is decomposed, the phosphorus combining with the iron, we are not at all surprised to find nearly the whole of the phosphorus, introduced in the charge at the top of the blast-furnace, concentrated in the pig metal. The greater the temperature of the furnace hearth, and the longer time the ore is exposed to this temperature in the zone of fusion, the greater is the amount of phosphorus concentrated in the metal. The slag, run from furnaces working at a high temperature, making No. 1 and 3 pig-iron, rarely contains more than 0·55 per cent phosphoric acid, and frequently not more than a trace. On the other hand, the slag from furnaces working at slow temperatures, producing rough white iron, very often contains from 0·10 per cent to 0·60 per cent.

Iron as a rule is in considerable quantity in slags containing much phosphoric acid, which fact clearly proves that reduction has been imperfect in the furnaces at the time of their production, that what failed to reduce the iron had also failed to reduce the phosphoric acid.

A great deal has been said about the power of fluor-spar when used as a flux in smelting ores containing phosphorus, in removing the phosphoric acid, or preventing its passage into the metal.

In order to ascertain if this compound of calcium and fluorine had any beneficial effect, the following experiments were made.

1. An ore calculated to yield pig metal containing 1·8 per cent. phosphorus, if all were reduced, was smelted in a crucible with 25 per cent fluor-spar. The metal produced contained 1·80 per cent. P, showing that the whole of the phosphoric acid had been reduced.

2. Two equal portions of calcined Cleveland stone were smelted in separate crucibles—one with lime in the usual way, and the other with 100 per cent. fluor-spar. The metal produced in each case was tested for phosphorus, with the following results, viz.:

Smelted with lime .. .. 1·627 per cent
,, fluor-spar .. 1·630 ,,

From which result we may conclude that fluor-spar is of no value in the smelting process as an agent for removing phosphorus.

Iron and Phosphorus.

By direct addition of phosphorus to iron heated in a crucible, I have obtained combinations containing between 6 and 27 per cent phosphorus. This result is different from what we might have expected, considering that our most eminent metallurgist, Dr. Percy, has stated, that iron will not take up more than 8·4 per cent. phosphorus when heated together in the manner described.

This element makes very fusible compounds with iron.

Judging from a large number of experiments, the fusion point decreases with each addition of phosphorus, until a compound, containing from 10 to 12 per cent of phosphorus is produced, which is the most fusible; after which each addition makes the compounds less and less fusible.

Phosphide of iron, containing about 11 per cent phosphorus, is quite fluid at a bright red heat; whereas, when

25 per cent is present, the compound is infusible at that temperature.

All the phosphides of iron are exceedingly brittle. Those containing the largest proportion of phosphorus are the most so. The combination of 75 of iron with 25 of phosphorus is capable of being ground up like sandstone in an agate mortar to an extremely fine powder.

The Compounds in which Phosphorus Exists in Cleveland Metal.

When Cleveland pig-iron is melting in a puddling furnace, there appear to be, near the complete fusion point of the iron, certain parts of the metal more fusible than others. If a partially fused pig be broken, the fractured surface presents throughout glistening, apparently fluid portions, thoroughly interspersed with particles of metal which have not become fluid. Judging from the comparative fusibility of phosphide of iron, it was thought that, if separate compounds of iron and phosphorus existed in pig metal, these compounds would be more fusible than the bulk. In order to ascertain if such is the case, about 1 cwt. of Cleveland iron was poured into a mould. After it had become viscous extreme pressure was applied by means of a hydraulic ram, and the portions of metal last fluid expressed. The analyses given below indicate with what result, viz. :—

	Metal used.	Metal expressed.
Iron	93·125 per cent ..	90·122 per cent
Carbon.. ..	3·000 ,, ..	1·750 ,,
Manganese ..	0·355 ,, ..	0·288 ,,
Silicon	1·630 ,, ..	0·790 ,,
Sulphur ..	0·120 ,, ..	0·060 ,,
Phosphorus	1·530 ,, ..	6·840 ,,
Titanium ..	0·240 ,, ..	0·150 ,,
	100·000	100·000

The metal expressed may be considered to be a combination of phosphide of iron and unaltered pig metal.

Assuming that the silicon in the expressed portion represents the proportion of unaltered metal, we have—

$$\frac{100 \times 0{\cdot}79}{1{\cdot}63} = 48{\cdot}5$$

of such metal, and $100 - 48{\cdot}5 = 51{\cdot}5$ of phosphide. By calculation we find the composition of each of these parts to be as follows, viz. :—

	Unaltered Metal.	Phosphide of Iron.
Iron	45·167 per cent ..	44·955 per cent
Carbon ..	1·455 ,, ..	0·295 ,,
Manganese ..	0·172 ,, ..	0·116 ,,
Silicon	0·790 ,, ..	—
Sulphur ..	0·058 ,, ..	0·002 ,,
Phosphorus	0·742 ,, ..	6·098 ,,
Titanium ..	0·116 ,, ..	0·034 ,,
	48·500	51·500

Not taking into consideration the very small proportion of the elements other than phosphorus and iron present, which together amount to only 0·447 part, we have iron and phosphorus in the following proportion expressed in per cents, viz :

Iron	88·05 per cent
Phosphorus ..	11·95 ,,
	100·00

Calculated into chemical equivalents by dividing each by their respective atomic weight, we have—

$$\frac{88{\cdot}05}{56} = 1{\cdot}57$$

and—

$$\frac{11{\cdot}95}{31} = 0{\cdot}385,$$

that is, we have the equivalents in the ratio of 1·57 iron to 0·385 phosphorus, or—

$$\frac{1{\cdot}57}{0{\cdot}385} = 4$$

equivalents iron to 1 of phosphorus, and therefore may be written Fe_4P.

About six months after the above experiment was made, it was repeated, and, as will be seen by what follows, with almost the same result.

	Metal used.	Metal expressed.
Iron	92·36 per cent ..	89·70 per cent
Carbon.. ..	2·84 ,, ..	2·00 ,,
Manganese ..	0·28 ,, ..	0·24 ,,
Silicon	3·01 ,, ..	1·51 ,,
Phosphorus..	1·46 ,, ..	6·52 ,,
Sulphur ..	0·05 ,, ..	0·03 ,,
	100·00	100·00

The expressed metal in this case contains by calculation 50 per cent of unaltered iron, and 50 per cent of phosphide, the composition of each being as stated below, viz. :—

	Unaltered Metal.	Phosphide of Iron.	
Iron	46·18 per cent ..	43·53 per cent	
Carbon ..	1·42 ,, ..	0·58 ,,	} 0·68 per cent
Manganese	0·14 ,, ..	0·10 ,,	
Silicon ..	1·50 ,, ..		
Sulphur ..	0·03 ,, ..		
Phosphorus	0·73 ,, ..	5·79 ,,	
	50·00	50·00	

Calculated into 100 parts, this phosphide would contain viz. :—

Iron	88·26 per cent
Phosphorus ..	11·74 ,,
	100·00

This also may be considered as Fe_4P.

It is very clear from these results that phosphide of iron does exist in a separate state in pig metal intimately diffused throughout the mass.

We now turn your attention to a different method of investigation.

All who have immersed bar iron in dilute acids, such as hydrochloric or sulphuric acids, must have noticed a black residue adhering to the outside of the iron. It is this substance which must now occupy our attention.

Metal, which had been deoxidised and desiliconised containing 1·6 per cent of phosphorus, was treated in fine powder to the action of hot dilute sulphuric acid. After all that was capable of being dissolved had passed into solution, a dense black residue remained, insoluble in sulphuric acid. This residue was filtered off, washed, dried, and weighed. The weight was a little over 2 per cent of metal used. On analysis it was found to consist of phosphide of iron together with a minute quantity of silica, carbonaceous matter, and titanic acid. The iron and phosphorus were present in the proportions of 3 equivalents of iron to 4 equivalents of phosphorus, and therefore may be expressed as Fe_3P_4.

A second experiment gave the same result.

Two samples of puddle bar, treated in the same manner, also left a residue of phosphide of the above-mentioned composition.

I have also found phosphides in residues from other samples as Fe_3P_2.

The proportion of phosphorus left in the insoluble phosphide varies very considerably, differing widely in different samples of iron, in some being as much as one-third, and in others only one-tenth of the total amount.

These facts I think clearly prove that there exist two or more different phosphides in iron containing phosphorus,

and that they exist in very varying proportions in different samples of iron.

The causes which produce these different compounds I have not been able to fathom. I hope, however, on further investigation to bring this matter to light.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.

A GENERAL MEETING was held at 116, Victoria Street, S.W., on Thursday, July 5th, Mr. R. H. SCOTT, F.R.S., in the chair.

The following papers were read and discussed:—

"*On a New Manganesian Garnet from Several Localities in Scotland*," by Prof. M. F. HEDDLE, of St. Andrews.

"*On Cotterite, a New Variety of Quartz from Ireland*," by Prof. HARKNESS, of Cork.

"*On Youngite*," by Mr. J. B. HANNAY, of Owens College, Manchester.

"*On the Artificial Production of Psilomelane*," by Mr. J. B. HANNAY.

"*On Penwithite, a new Hydrous Manganesic Silicate from Cornwall*," by Mr. J. H. COLLINS.

"*Notes on Cornish Minerals and Localities*," by Mr. J. H. COLLINS.

The Annual Meeting was fixed for Wednesday, August 14th, at 2.30 p.m., to be held at Dublin.

NOTICES OF BOOKS.

Phosphates in Nutrition, &c. By M. F. ANDERSON L.R.C.P. Edin., and M.R.C.S. Eng. London: Baillière Tindall, and Cox, 1878.

WE welcome the appearance of this book as an additiona example of the increasing interest taken by the medica profession in the application of the principles of chemistry to medicine and diet. The importance of each and all of the inorganic substances contained in the food of man is but too frequently overlooked, by even the shining lights of the medical world, most of whom are only too apt to look on chemistry as a dry and disagreeable subject to be coached up for examination and then laid aside. We could, however, cite many examples of medical men who are also chemists, and the importance of the work done by them ought to lead the rising generation of medical students and workers to regard chemistry as part and parcel of their own special science, and as necessary to the trained surgeon or physician as anatomy and physiology. Digestion, assimilation, and disorganisation are as much chemical processes as dyeing or iron smelting, and a physician or a surgeon who is not a chemist as well cannot be said to be armed at all points for the battle which he daily wages against disease and death.

Dr. Anderson's theory, as we understand it, is that certain diseases which have hitherto puzzled the medical profession are due to a lack of what the author calls tissue phosphates, *i.e.*, soluble tribasic salts in the various tissues, especially in the capillaries and the inner arterial lining, which are much richer in phosphatic salts than any of the other tissues. That the tissues may be kept in a thoroughly healthy state, the author asserts that not only is a certain amount of tribasic phosphatic salts necessary, but that they must be exhibited, whether as food or medicine, in a soluble form or in conjunction with a solvent. The efficacy of lime-juice in scurvy, for instance, lies not so much in the phosphatic and potassic salts contained in it, but in the citric acid, which, according to Dr. Anderson, is the most powerful solvent of the insoluble phosphates that we possess, and that without producing any decomposition as in the case of the mineral acids. Dr. Anderson lays great stress on using phosphoric acid in combination with the proper basis, and decides that the administration of the element phosphorus can be of but little service, seeing that it must be oxidised in the system and united with the proper bases before it can be assimilated. For this reason the phosphorus preparations of the British Pharmacopœia are incapable of easily forming tribasic phosphates such as those formed in the tissues. From a chemical point of view, Dr. Anderson's theory seems to be fully borne out by the numerous analyses which he gives throughout the book, and his conclusions are, so far, the only possible results of his premisses; whether he is right physiologically time alone can tell.

As an example of the way in which purely chemical principles may be applied to the investigation of the causes and cure of certain diseases Dr. Anderson's book has a very high value, and we gladly recommend it to those of our readers who believe that the balance and test-tube are efficient handmaidens of the scalpel and dissecting knife.

Aids to Chemistry. Part II., Inorganic. The Metals by C. E. ARMAND SEMPLE, B.A., M.B., M.R.C.P. Lond. London: Baillière, Tindall, and Cox, 1878.

OF writing and publishing elementary manuals of chemistry there is literally no end. There is nothing original about Dr. Semple's book except the preface, in which he heartlessly tells us that "contributions have been freely levied on the admirable works of Miller, Fownes, Roscoe, Bernays, and especially upon the "Chemia Coartata" of Professor Kolmyer. On the title-page we are told that the book is for students preparing for examinations; we are afraid, however, that the student who presented himself for examination, without any knowledge of such chemically important elements as Va, Te, W, and a number of others purposely omitted by Dr. Semple, would fare somewhat badly. The work is an unusually bad specimen of cram book-making. It is nothing more than a meagre list of chemical facts loosely strung together, apparently for the purpose of being learned by heart.

CORRESPONDENCE.

WORKING UP NAPHTHALIN FOR USEFUL PRODUCTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxxvii., p. 258, is a paper by Mr. J. Marzell on the above subject. He quotes from a number of blue books, &c., showing what a variety of efforts has been directed to the obtaining of light-gas, oils, benzol, homologues, and anthracen, by passing naphthalin through red-hot tubes alone, or in presence of other bodies. The naphthalin has also in some instances been first treated so as to obtain a naphthalin compound or derivative, which has then been distilled. After reading this paper of Mr. Marzell's it struck me that some remarks thereon, from one who has tried all the experiments detailed, with many more besides, on the laboratory, and many of them on the practical, scale might be thought acceptable. Further, Mr. Marzell would appear to have become so deeply interested in patent specifications and specifications under provisional protection as to have forgotten to refer to or look up the memoirs or

journals of the scientific world, since he proposes for himself problems already solved, and describes results he has obtained, which seem to have given him certain false hopes to say the least.

With regard to efforts directed to obtaining light-gas from naphthalin by the action of heat upon the latter, it may just be mentioned that, on passing the latter through a long narrow tube with pieces of charcoal or pumice, and raised to an intense white heat, comparatively little decomposition takes place, and then pure hydrogen gas is evolved, and what distils over is a mixture of naphthalin with a small quantity of a mixture of the isomeric dinaphthyls, together with a brown polymeric dinaphthyl. By using lower temperatures, the above decomposition occurs, but to a much smaller extent. From the above it will readily be perceived how futile admixture of the naphthalin vapours with hydrogen must be in passing through the red-hot tube.

Working Up for Benzol Homologues.—The proposed process of passing naphthalin over heated peroxide of manganese I have already tried, and may just briefly say dinaphthyl is again formed in this case. Rowley's process, by first saturating with chlorine, with subsequent distillation, yielded me also, first, oils, and finally a fatty looking substance in small quantity. But how benzol was obtained by Mr. Rowley by simply dissolving this body in naphtha and then distilling, unless indeed the naphtha previously contained some benzol, I cannot comprehend.

Working Up for Anthracen. — With regard to Mr. Marzell's remarks under this head, I would solicit this gentleman's notice of *Proc. Lit. Phil. Soc.*, Manchester, (vol. v., series iii.), session 1870-71; or *Journ. Chem. Soc.*, 1871 (p. 1184), and succeeding numbers in 1873, 1876, and 1877.

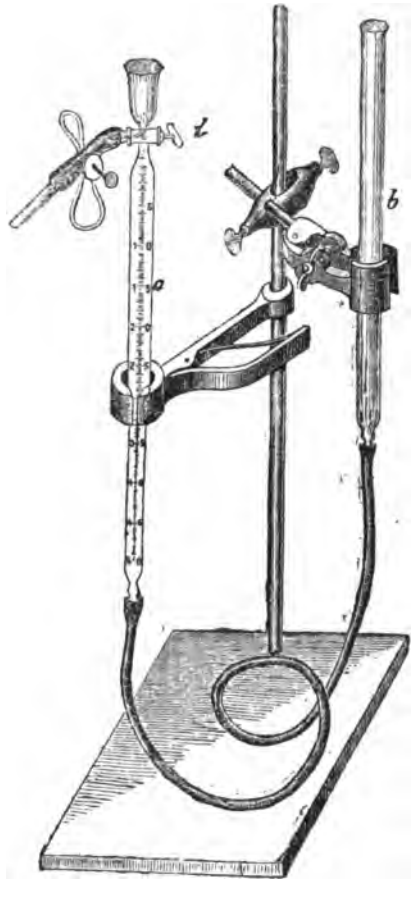
I may mention that when the product obtained as Mr. Marzell describes is oxidised with chromic acid, absolutely no anthraquinon is obtained; and, likewise, when the picric acid test of Fritsche is applied, it fails to discover the presence of the smallest trace of anthracen. I may in conclusion now just remind Mr. Marzell that the field in which he appears to contemplate a series of researches, or is actually so engaged, has been for the last eight or nine years, and is still, occupied. Further, that a tacit understanding exists amongst chemists—I may say an international understanding—that a field of labour taken up and wrought in by any given individual, notice being from time to time given by said individual of such occupation, that this field of work shall be honourably left to the worker and not intruded upon.—I am, &c.,

WATSON SMITH.

DETERMINATION OF NITROUS AND NITRIC ACIDS.

To the Editor of the Chemical News.

SIR,—Since the abstract of my paper on the determination of nitrous and nitric acids (from the *Berichte der Deutschen Chemischen Gesellschaft*), in your impression of 28th inst., will probably give to the reader a wrong idea of the purport of my paper I trust you will favour me with accepting the following more accurate abstract of the same. After having discussed a few unimportant contradictions between the results of Dr. Eder and my own, I continue by saying that all methods for the above-mentioned estimation founded on the use of oxidising reagents have certain drawbacks, where factory acids or similar impure substances are concerned, and that accordingly a method free from those drawbacks must be very welcome to chemists. *As such a method I quote the mercury process* invented by W. Crum, improved by Mr. John Watts, and lately recommended by Mr. Davis. It is true I mention that Mr. Davis has not given any proof of the accuracy of the method by the analysis of any pure substances, and of such as had been mixed with known quantities of impurities; but I continue by saying that on making those test analyses myself, *I have completely confirmed the accuracy of the method*, and have found it not to be interfered with by the presence of arsenious acid and of organic substances. For this I have given full experimental details, and I have warmly recommended the process. The apparatus I have constructed for it is certainly very different from that of Mr. Davis's, which requires a mercurial trough and 10 lbs. of mercury, has too short a tube for any accurate measurements being possible, and is a somewhat clumsy instrument as to manipulation. My own apparatus requires no trough and less than 2 lbs. of mercury, and allows of the



same degree of accuracy as the scientific methods of gas analysis; it is equally applicable for factory work and for the most exact scientific determinations, the latter taking no more time and trouble than any rough method. As it may interest many of your readers, I beg to hand you a sketch of the apparatus, which I have proposed to call "Nitrometer," and which I have now used for some time with great success. You will observe the measuring tube *a*, holding 50 c.c., divided in $\frac{1}{10}$ths, provided with a funnel *c*, and a two-bore glass cock *d*, hanging in an instantaneously opening spring-clamp; an elastic tube connects *a* with the plain tube *b* of equal size, sliding up and down in another clamp. First of all *b* is placed so that its lower end is nearly at a level with *d*; mercury is poured into *b*, till it has filled *a*, and has got into *c*; *d* is turned so as to close the communication between *a* and *b*,

and so run off the excess of mercury through the lateral bore; *b* is lowered in its clamp, and 1 c.c. of the nitrous vitriol, &c., to be tested is introduced into *c*, by means of an accurate pipette. By carefully turning *d*, the acid is sucked into *a* without any air following, and *c* is rinsed out by a few c.c. of pure acid, run into *a* in the same way. *a* is now taken out of the spring-clamp, violently shaken for two minutes (no more is necessary), replaced in the clamp, and *b* adjusted, so that the levels of mercury of both tubes are equal, except that an allowance is made in *b* for the acid contained in *a*, ½th of the height of the latter being either allowed for as an addition to the mercury in *b*, or else being deducted from the barometrical pressure. After the temperature has become constant (¼ hour suffices for factory work, 1 hour for exact analyses), the volume of gas in *a* is read off (which can be done to $\frac{1}{10}$c.c.) and reduced to 0° and 760 m.m. in the usual way. Each c.c. at 0° and 760 m.m. corresponds to 1·343 m.gr. NO = 1·701 m.gr. N_2O_3 = 2·417 m.gr. N_2O_5 = 3·805 m.gr. NO_3Na, &c. Now *d* is opened, so that *a* and *c* communicate, *b* is raised, and thus first the gas then the acid are driven into *c*, from whence the acid is run away by the lateral bore of *d*; everything is now ready for a new test.—I am, &c.,

G. Lunge.

Zurich, July 1, 1871.

MAGNETIC FIGURES.

To the Editor of the Chemical News.

Sir,—In your last issue you published the report of a meeting of the Physical Society on Saturday June 22nd. In that report it is stated that Prof. S. P. Thompson exhibited a series of "magnetic figures illustrating electrodynamic relations." These figures are produced by fixing upon glass plates the curves obtained by the use of iron filings scattered in a magnetic field. There are probably few who deliver courses of lectures upon electricity and magnetism who have failed to make use of some such simple device for showing the nature of a magnetic field as that now dignified by the term "magnetic figures illustrating electrodynamic relations." But the very device used has also been employed. At a lecture upon the "Telephone" which was delivered at the Bristol Trade and Mining Schools in April last, I exhibited some of these figures upon the screen, and described the method of preparing the plates, which method is *exactly* similar to that now employed by Prof. Thompson. Many of these plates (perhaps a greater variety than those shown to the Physical Society), prepared in a similar manner, now lie in the Physical Cabinet at that Institution, and have been rather extensively used, both in my own and other classes.

One of Prof. Thompson's students was present at this lecture, and a full report appeared in the Bristol papers.

Ernest H. Cook.

Ilfracombe, July 4, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 22, June 3, 1878.

Direct Fixation of Carbonic Acid, of Sulphurous Acid, and of Phthalic Anhydride upon Benzol; Synthesis of Benzoic Acid, of the Hydride of Sulpho-phenyl, and of Benzoyl-benzoic Acid.—O. Friedel and J. M. Crafts.—The syntheses which the authors have effected have their analogues in the reactions of sodium-ethyl and of zinc-methyl, and seem difficult to understand without admitting the formation of an organo-metallic combination of aluminium by the reaction of this metal upon the hydrocarbides. On passing a current of carbonic acid, dried by traversing tubes filled with pumice moistened with sulphuric acid and with phosphoric anhydride, into benzol mixed with aluminium chloride, and kept at a heat near its boiling-point, a small quantity of hydrochloric acid is evolved. After a considerable time, which may amount to several days, the process is arrested and the mixture treated with water. The upper layer is decanted, and, after having filtered the watery stratum through a moistened filter, a small quantity of sulphuric acid is added, and the whole is moistened with ether. The ether, after being decanted and distilled, leaves a crystallisable body, which is benzoic acid.

Manufacture of Cast Manganese, and Volatility of Manganese.—P. Jordan.—The author presented to the Academy a specimen of cast-metal obtained by treating ores of manganese in the blast-furnace. Its composition is—

Manganese	84·960
Iron	8·550
Carbon	5·700
Silicon	0·660
Sulphur	0·035
Phosphorus	0·005
	99·910

In subsequent operations the percentage of manganese has been carried as high as 87·4. The specimen laid before the Academy has been preserved for six months without having undergone any sensible alteration. There is a considerable loss of manganese in the furnace, amounting sometimes to 10 per cent, which, with certain other facts, seems to argue in favour of the volatility of this metal at elevated temperatures.

Thermo-chemical Examination of Certain Derivatives of Phenol.—W. Longuinine.—The author concludes that the heat of combination of the substitution products of phenol increases in proportion to the number of times that the residue NO_2 is introduced.

On Vapour Densities.—L. Troost.—The author has examined acetic and hyponitric acids, and finds that both behave like sulphurous acid, cyanogen, &c. He has also repeated his experiments on chloral hydrate, and finds his former results confirmed.

On Metallic Allotropism.—P. Schützenberger.—The facts relative to copper which the author has laid before the Academy are by no means isolated. Everything favours the view that by the electrolysis of metallic solutions under favourable conditions, which may vary for each metal, instances of this kind may be multiplied. Former experiments upon lead establish the existence of an allotropic modification of this metal characterised by an oxidability much superior to that of normal lead.

Reciprocal Combinations of the Metallic Sesquisulphates.—A. Etard.—The persulphates are capable of combining so as to form salts of the general formula $M_2(SO_4)_3,N_2(SO_4)_3$, and the compound thus formed can in its turn take up sulphuric acid so as to form more complicated acid compounds. The author has studied the double sulphates of the sesquoxide of iron and aluminium, of iron and chromium, of aluminium and chromium, aluminium and manganese, &c.

On Certain Compounds of Platinum.—D. Cochin.—The author has obtained a diplatino-phosphoric chloride of the formula $PCl_3.2(PtCl_2)$. He has also formed compounds of the subchlorides of platinum with aniline and toluydin analogous to the green salt of Magnus, and has combined aniline and toluydin respectively with the ethylic and methylic diphospho-platinic ether.

Volumetric Determination of Arsenic.—MM. A. Millot and Maguenne.— The form in which arsenic, when isolated, is most often determined, is the ammoniaco-magnesian arseniate. The precipitation is rarely complete even in presence of a great excess of magnesia; and the authors have often observed that in the filtrate, after concentration and acidification, hydrosulphuric acid produces a slight yellow turbidity of arsenic sulphide. Further, the precipitate cannot be ignited, but must be weighed with its filter. They propose as a substitute the volumetric process already in use for phosphoric acid. It is known that, in a neutral or slightly acid liquid, arsenic acid is completely precipitated at the boiling-point by uranium acetate. If reagent is added drop by drop it becomes apparent when the precipitation is complete by the brown tint which a drop of the liquid takes when brought in contact with a drop of potassium ferrocyanide placed upon a porcelain plate. If the uranium solution has been standardised with a known volume of pure arsenic acid, the quantity of arsenic in the liquid is easily calculated. On account of the high equivalent of arsenic acid it is necessary to employ a solution of uranium more dilute than for phosphoric acid, 20 grms. acetate of uranium per litre being a suitable strength. Each c.c. of such a solution precipitates about 5 m.grms. of arsenic acid. The solutions of sodium acetate and of ferrocyanide are of the same strength as those employed for phosphoric acid. The ferrocyanide should have been prepared recently. The process requires that the arsenic acid should be completely separated from all the bases with which it may form compounds insoluble in weak acetic acid. This end is easily attained by decomposing, with pure fuming nitric acid, the arseniuretted hydrogen which the substances produce in Marsh's apparatus. After two hours the volatilisation of the arsenic is generally complete, as may be ascertained by igniting the gas escaping from the apparatus. The liquid which contains all the arsenic at the maximum stage of oxidation is then separated to dryness, re-dissolved, mixed with 10 c.c. of acetate of soda, and titrated with uranium. If the arsenic is mixed with antimony the latter is deposited during the evaporation, and does not interfere with the subsequent process.

Researches on the Nitrogenous Acids derived from the Acetones.—G. Chancel.—The author refers to a compound which he obtained in 1844, and named butyro-nitric acid. Three years later he considered it as nitro-propionic acid, but now he prefers to name it propyl-nitrous acid. The analyses of this acid and of its salts agree with the formulæ for dinitro-propane and its derivatives, as obtained by M. ter Meer.

On Meno-chlor-ethyl-acetamide.—T. H. Norton and J. Tcherniak.—This compound, to which the authors assign the formula—

$$N\begin{cases}CH_{22}O\\C_2H_5\\Cl,\end{cases}$$

is a very mobile liquid, neutral to test-paper, possessing an irritating odour, and being soluble in all proportions in water, alcohol, and ether. Analogous compounds are formed by the action of bromine upon ethyl-acetamid.

On Ethylen Cyanide.—Milan Nevolé and J. Tcherniak.—The authors have succeeded in preparing this compound, $C_4H_4N_2$, as a white brilliant solid, perfectly amorphous; soluble in water, alcohol, and chloroform, but sparingly soluble in carbon disulphide. It melts at 54·5°, and solidifies at 53°.

Researches on the Peptones.—A. Henninger.—The peptones derived from fibrin, albumen, or casein appear as white, amorphous, infusible powders, very soluble in water and in glacial acetic acid. They have a slight acid reaction, and behave like weak amido-acids. On examining the action of a great number of reagents upon the various peptones, the author has not been able to distinguish any difference in their respective behaviour. Whilst possessing certain characters in common with the albuminoids, they differ as a class by a smaller tendency to coagulation and precipitation. They approximate remarkably to gelatin, but their hot solutions do not form a jelly on cooling. Their rotatory power varies, being most feeble in albumen pepton, and highest in casein pepton.

Method of Separating and Determining the Stearic and Oleic Acids derived from the Saponification of Tallow.—J. David.—This method is based on the novel fact that if acetic acid is dropped into an alcoholic solution of oleic acid a moment arrives when the oleic acid suddenly separates. Thus, if at a temperature of 15° 1 c.c. of oleic acid is dissolved in 3 c.c. of alcohol at 95 per cent, and if into this liquor there is dropped a mixture of equal volumes of water and of glacial acetic acid, the separation of the oleic acid—which does not even begin on the addition of 2·2 c.c. of the acetic acid—is completed by 2·3 c.c.; *i.e.*, a difference of $\frac{1}{10}$. It is not the same with the alcoholic solution of stearic acid, which begins to precipitate on the addition of the first drop. Further, stearic acid, which is insoluble in the mixture of alcohol and acetic acid, is equally insoluble when the mixture contains oleic acid. The authors effect the separation of the two fatty acids as follows:—They mix in a flask or litre of glacial acetic acid with a litre of water. Operating at 15°, they pour into a small tube graduated in tenths 1 c.c. of pure oleic acid, then 3 c.c. of alcohol at 95 per cent, and finally 2·2 c.c. of the acetic acid. So far nothing ought to be precipitated, but if, on adding $\frac{1}{10}$ c.c. of acetic acid, a turbidity appears, and if above the mixture of alcohol and acetic acid there floats 1 c.c. of oleic acid, it may be inferred that the sample is good. If not, the proportions are varied until the point of precipitation is hit within 0·1 c.c. of acetic acid. When this end is attained, alcohol and acetic acid are mixed in the proportions indicated by the preliminary trial—for instance, 300 of alcohol to 220 of acid. In the meantime they add to the alcoholic-acetic mixture 1 grm. or 2 grms. of pure stearic acid cut in fragments, and, finally, the lower end of the exit tube of the washing bottle is fitted with a small piece of sponge, so that when operating they may always have a clear liquid, free from undissolved stearic acid. When not in use both apertures of the washing bottle are kept well-stoppered, in order to prevent the evaporation of the alcohol. The analysis is then performed as follows:—0·95 (grm. ?) of the fatty acid to be analysed is weighed into a thin tube-flask, fitted with a well-ground stopper. Upon it are poured 15 c.c. of the alcoholic mixture; it is repeatedly shaken up, and left for twenty-four hours in a cellar of the maximum temperature of 15°. The oleic acid being then entirely dissolved, the whole is thrown upon a small filter, in a funnel whose edges are ground and covered with a glass plate. The stearin remaining upon the filter is washed with the same mixture of alcohol and ether with which the filter is fitted three times in succession, thus rendering it perfectly free from oleic acid. The stearic acid is then entirely washed from the filter into a tared platinum capsule by means of a stream of cold water from a washing bottle with a very slender orifice. The capsule is then heated in the water-bath, and when the stearic acid has collected on the surface of the water, as an oily cake, it is allowed to cool. The water beneath this solid matter is decanted off, and the stearic acid is completely dried at 100°, or better in a vacuum. It is then weighed, and the weight, less that of the empty capsule, gives the proportion of stearic acid in 95 of the fatty acid.

Moniteur Scientifique Quesneville. Sèrie 3, Tome viii., June, 1878.

Dissociation of the Salts of Aniline.—M. Goppelsroeder.—The salts of aniline, toluydin, and naphthylamin are decomposed into acid and base so completely by water that such salts in an aqueous solution may be

advantageously titrated with a normal solution of potassa. The aqueous solution of these salts behaves like the solution of the free acid in the salts. The author announced at the same time that on passing a galvanic current through a hot and concentrated solution of a salt of aniline, he had obtained at the positive pole a pure green deposit which appeared to be emeraldin. This deposit turns black on oxidation.—*Bulletin de la Soc. Ind. de Mulhouse.*

Discharge on Vat Blues.—M. Oscar Scheurer.—Minium, or lead sesquioxide, if printed on cloth which is dyed blue in the vat, and then passed through cold and weak hydrochloric acid, gives very clear and well-defined whites. If the passage through the acid takes one minute, a strength of ¼ degree B. (?), or 25 c.c. of the commercial acid to a litre of water, suffices for the production of a pure white. The cloth is then passed through boiling water to remove the lead chloride formed. If with the minium are mixed other insoluble colours, such as terra di sienna, ochre, chrome yellow, Guignet's green, &c., thickened with albumen a variety of discharge colours are obtained. But it is requisite to steam before the passage through acid in order to coagulate the albumen. The defect of this procedure is the impossibility of entirely removing the lead chloride.—*Bull. de la Soc. Ind. de Mulhouse.*

Simultaneous Action of Ferricyanide of Potassium and certain Acetates upon Indigo.—M. Alb. Scheurer.—If a swatch of vat-blue cloth upon which a design has been printed with potassium ferricyanide mixed with any acid is steamed, the indigo is destroyed. The destruction of the colour is directly as the power of the base whose acetate is used and inversely as the energy with which the same base retains the acetic acid at the temperature of 100°.

Candles for the Blowpipe.—M. Paul Casamajor.—See page 14.

On Ashes sold for Bleaching Linen.—M. E. Feray.—An account of the various kinds of wood-ashes, &c., sold in France as a source of alkaline lyes. The fact is mentioned that the annual cost of washing linen, &c., in France, is 1½ milliards of francs.

Researches on the Fermentation of Dextrin.—M. Barfoed.—A solution of pure dextrin may enter into alcholic fermentation under the influence of yeast alone, though the fermentation progresses much more slowly than with sugar. The gas disengaged consists exclusively of carbonic acid, other products of fermentation not being formed in appreciable quantity. There is no proof that the dextrin is previously transformed into glucose.

Researches on the Aromatic Amines.—MM. E. Noelting and F. Reverdin.—Monomethyl-orthotoluydin is a colourless oil, of a peculiar odour, boiling at 207—208° and having at 20° the sp. gr. 0·973. If oxidised by the process followed in the manufacture of methylanilin violet, it yields a fine violet-red colouring matter, whilst its isomer, monomethyl-paratoluydin, described by M. A. Thomson, yields a brown colour.

The Blue Solution of Molybdic Acid as a Reagent.—M. O. Maschke.—If calcium molybdate is moistened with a quantity of dilute hydrochloric acid sufficient to produce a clear solution on the application of a gentle heat, a deep blue colouration quickly appears in the liquid. In place of calcium molybdate those of ammonium, sodium, or potassium, may be used, adding so much hydrochloric acid that the liquid if poured upon a plate of polished marble may produce a visible but very slight effervescence. If after cooling a concentrated solution of sodium or calcium chloride is poured into the liquid there is formed a blue-black precipitate, not easily distinguished in the liquid, and which may be regarded as a compound of molybdic acid and molybdic oxide. It dissolves with great ease, not merely in water but also in alcohol, and produces a colouration of extraordinary intensity. The author prepares the solution as follows:—3 grms. calcium molybdate, 250 c.c. of water, and enough of hydrochloric acid to effect the solution of 2 grms. of cane- or grape-sugar. When the deep blue colouration is apparent the ebullition is continued for five minutes. When the precipitate has been produced with sodium or calcium chloride, it is washed upon the filter first with the precipitant and then with a little water. As soon as the liquid begins to run through of a deep blue colour, the filter with its contents is placed in distilled water and the solution finally made up to 250 c.c. This blue solution is decolourised with extreme ease by caustic alkalies and oxidising agents, such as chlorine, nitrous acid, hydrogen peroxide, and permanganic acid. Hydrochloric acid of sp. gr. 1·24 produces in this solution a blue precipitate, the supernatant liquid being colourless. Sulphuric acid of sp. gr. 1·840 does not give a precipitate, but the colour of the liquid is altered. Nitric acid of sp. gr. 1·185 produces a rapid decolouration. Dilute solutions of ferric salts decolourise, and those of ferrous salts occasion turbidity. The author has endeavoured to employ the blue solution to detect nitrous acid in spring waters. The water under examination is mixed with a little caustic soda; after filtration, so much acetic acid is added that the liquid may have but a very feeble acid reaction. A test-tube is three-fourths filled with this liquid and about 6 to 10 drops of dilute acetic acid and 1 to 2 drops of the blue molybdic solution are added, so that, in placing the tube upon a white surface and viewing it longitudinally, only a very slight blue colouration may be perceived. Water containing only some tenths of a milligrm. of nitrous acid per litre will certainly destroy the colour in an hour. The rapidity and distinctness of the reaction are remarkably increased on heating the liquid mixture gently for a short time. Solutions of potassium nitrate, containing $_{1}{}_{5}$th of a millionth of nitrous acid per c.c., are decolourised in a few minutes after being gently heated. A strong and prolonged heat is to be avoided. Attempts made at the titration of nitrous acid by means of the blue molybdic solution, have so far given unsatisfactory results. Still if we admit that 1 mol. of permanganic acid corresponds to 5 mols. of molybdic oxide, it is easy to determine with precision the quantity of molybdic oxide contained in a liquid by titration with permanganate. It might therefore be possible to determine nitrous acid in a satisfactory manner, by causing the blue solution of molybdic acid to react for a certain time, the length of which must be experimentally determined, and then titrating back with permanganate. The blue solution is not very stable.—*Zeitschrift für Anal. Chemie.*

Process for the Detection of Molybdic Acid.—M. O. Maschke.—According to Schoenn traces of molybdic acid and its compounds may be discovered by the blue colouration produced on heating it with concentrated sulphuric acid in a porcelain capsule. This test is rendered exceedingly convenient, and much more certain by the following modification: a little concentrated sulphuric acid is applied to a piece of platinum foil, bent so as to form a slight depression; upon the acid is placed a little of the substance in powder, and the foil is heated till vapours escape in abundance; it is then let cool and repeatedly moistened with the breath. When after cooling only minute blue spots are visible, the sulphuric acid after being breathed upon takes an intense blue colouration. On heating the platinum foil, the blue colour vanishes, but reappears on cooling. It is completely decolourised if a considerable quantity of water is added.—*Zeitschrift für Anal. Chemie.*

On Chromic Phosphate.—Phosphoric acid in combination with chrome may be easily overlooked in following the method indicated in Will's tables, when chromic oxide and chromic phosphate are obtained simultaneously in solution in potassa. On boiling this solution to precipitate the chrome, the phosphate is entirely decomposed, and not a trace of phosphoric acid is precipitated with the oxide of chrome.—*Zeitschrift für Analyt. Chemie.*

July, 1878.

Chemical Industry at the Exhibition of 1878.—M. Adolphe Kopp.—The branches discussed in the present issue are sulphur, bisulphide of carbon, sulphuric acid, and alkali. Little appears to have been done in the last few years towards improving the manufacture of sulphuric acid. M. de Hemptinne causes the sulphurous acid derived from the combustion of pyrites to pass through two concentric chambers, so that the impurities may be deposited. The top of the chambers is occupied by a vat in which the concentration and denitrification of the acid is effected. This vat is of sheet-iron and it is lined with lead. Its bottom is traversed by 100 tubes of lead, one metre long and 50 centimetres in diameter. In each tube is suspended another more slender, the lower extremity of which is open almost like the steam-tubes in Field's boiler. This second tube opens at 10 centimetres from the bottom, and serves to feed the former with weak acid. In this manner a constant current of acid is established in the tubes, and it is concentrated to 61° B. In order to denitrify it, the vat is covered, and by means of a leaden tube the sulphuric acid which has already entered the chamber is aspired; it is pressed by a sort of Giffard's injector through the nitrous sulphuric acid and the watery vapours derived from the evaporation. The sulphurous acid loaded with nitrous vapours returns into the chambers by another tube. The lead chamber in which the transformation is to take place with extreme rapidity is lined with sheets of lead and filled with 5200 earthern bottles fitted with holes. The nitric acid enters the chamber by means of a Welter's funnel, and weak sulphuric acid is thrown over the bottles at regular intervals. No steam enters the chamber, except the jet which is between the chimney and the Gay-Lussac towers. There is no information as to the practical value of this process. The drums and the cascade-apparatus for denitrifying the acid, as described in the works of Knapp and Wagner, have not been generally introduced into manufactories. These systems differ from Glover's tower, inasmuch as water plays the part of denitrificator as the gases enter it saturated with moisture. Probably the great waste of lead has caused these contrivances to be rejected; in fact, the weak sulphuric acid which runs down the sides is saturated with weak sulphuric acid, and is of course highly destructive to lead. The drums have been replaced by large stoneware bottles, similar to those employed for the condensation of hydrochloric acid, and filled with fragments of coke. In these denitrification is well effected, vapour of water being used, not sulphurous acid. The acid is concentrated to 48° B. Latterly various interesting communications have been published concerning Glover's tower, and this apparatus, which in 1873 was only known for concentrating the acid, seems to become more generally used, not merely for this purpose but also for denitrification. On this point a brisk controversy has sprung up in the English and German journals. M. Kuhlmann having studied the action of sulphurous acid upon the binoxide of nitrogen and hyponitric acid, proved that the oxides of nitrogen are to a great extent reduced to protoxide. MM. Pelouze, Fremy, and Weber have arrived at the same conclusions. In presence of water the reaction goes still further. M. Vorster has come to the same results, and applying his laboratory experiments to the reactions which take place in Glover's tower, he argues that though the process of denitrification is complete in this apparatus, it is carried too far, nitrous oxide and even free nitrogen being formed with a loss of 40 to 70 per cent. Thus in England alone the loss would be equal to 3600 tons nitrate of soda annually. On the other hand, Dr. Lunge considers that the English manufacturers could not but have become aware of the loss attending the new process, had such really existed. But no greater quantity of nitre is decomposed than by the old process—2·14 per cent of the sulphur employed, or if without a Gay-Lussac's tower 3 per cent. He further explains the differences which have arisen between theory and practice. It has been certainly proved that nitric oxide is easily reduced by sulphurous acid to nitrous oxide and even to nitrogen, nitrous acid less readily and nitric acid least readily of all, but only under conditions which do not occur in practice. The experimentalists above mentioned have, *e.g.*, caused the gases to react upon each other in a state of purity, whilst in Glover's tower the sulphurous acid is mixed with a large excess of air. The process of denitrification is chiefly effected in the upper part of the tower where the gases are coolest, the temperature of the acid being never above 120°—140°. There are nevertheless two cases where Glover's tower cannot be used. If the nitrous sulphuric acid coming from the Gay-Lussac towers is contaminated with impurities extracted from the coke, the temperature of the Glover's towers is not elevated enough to burn these organic particles; the acid remains brown, and this colouration disappears but slowly, until the coke has been used for several months. The Gay-Lussac towers might indeed be filled with some other substance, but such is not easy to find, on account of the low price of coke, its porosity, and its resistance to acids. If the pyrites used contain much ash, the result will be an impure acid containing much iron. The author describes next the improvements in apparatus for the concentration of chamber acid, speaking very highly of that devised by Messrs. Johnson and Matthey, of Hatton Garden, and now on view in the English section of the Exhibition. The methods proposed for the removal of arsenic present in sulphuric acid are not pronounced perfectly satisfactory, the best being that of Dupasquier, who adds barium sulphide and hyposulphite.

Use of Soluble Glass in Bleaching Cotton.—M. R. Meyer spreads out the cotton to be bleached, without moistening it previously, in a chest fitted with squeezers, containing a solution of silicate of soda, and placed in an iron cylinder, open above, and fitted with a double bottom. The solution consists of 1 litre silicate of soda at 20° B., and 120 litres of water. When the cotton is saturated with this liquid it is further covered with a similar quantity of the same solution, and boiled for two hours. The liquid is drawn off strongly coloured, and is replaced by boiling water, which is kept in ebullition for an hour. This operation is repeated once more when the bleaching is complete, and the cotton is drained and washed. The first washings should be made with boiling water, for, if cold or luke-warm water is employed, the dirt is re-precipitated upon the cotton. For the same reason it is proper to pass the cotton through a centrifugal machine before washing.—*Muster-zeitung.*

Process for the Preservation of Wood.—It is recommended to char the wood superficially, and then, while still hot, to coat it with as much hot tar as it will absorb.

Manufacture of Violet Ultramarine.—M. J. Zellner.—The inventor claims the four following processes:—1. He passes a dry halogen, preferably chlorine, over blue or green ultramarine heated to 300°, and obtains the halogenic derivatives of ultramarine. 2. He heats blue or green ultramarine to 160° to 180°, passing into it chlorine (or some other halogen) along with the vapour of water. There is formed what the author terms hydroxylised violet ultramarine, along with chloride of sodium, which is eliminated by washing; 34 kilos. of chlorine are required for 100 kilos. of ultramarine. 3. Blue or green ultramarine is heated with a mixture of such salts as ammonium nitrate or chloride, or with any mixture giving off watery vapour and a halogen on the application of heat. There is formed violet hydroxylised ultramarine or, in presence of ammoniacal salts, "amidic ultramarine." 4. The conversion of ultramarine into violet ultramarine may be likewise effected more or less completely by submitting blue or green ultramarine at 160° or 180° to the action of an acid, an oxidiser, of water, or a mixture furnishing these three bodies.—*Muster-zeitung.*

Falsification of the Extract of Logwood.—Formerly this extract was adulterated with indifferent substances, so that the value of a sample could be ascertained by simply dyeing a swatch. Now the extract is sophisticated with colouring matters of less value, such as sumac, chestnut wood, gall-nuts, &c. [There is a mistake here: the cheapest gall-nuts cost twice the price of the dearest logwood.—*Ed.* Chem. News.] The following method may be recommended for detecting this new fraud. Exhaust 1 decigramme of the sample dried at 110° in the gramme of absolute ether, and weigh the residue after evaporation of the ethereal extract; treat the portion left undissolved by ether with alcohol, and compare the weights of these two extracts with those given by a normal extract of logwood. The extract of chestnut-wood being insoluble in ether, but soluble in alcohol, it is evident that a sophisticated extract will contain a larger proportion of matter insoluble in alcohol than a genuine sample. It may also be useful to make quantitative dyeing experiments with the portions respectively soluble in alcohol and ether.—*Journal de Fabricants de Papier.*

Manufacture and use of Chlorophyll.—MM. Secourt and Guillemare take the leaves of spinach, nettles, &c., and macerate them in water. The whole is then boiled with an equal weight of soda-lye at 12·5° Baumé, and the liquid thus obtained is precipitated with alum. The lake thus yielded is washed and pressed and is then mixed with an equal weight of a soluble phosphate, an alkaline citrate, or a bitartrate, and then diluted with water down to 2° to 5° Baumé. This solution retains its colour and may be advantageously used for giving a green to preserved vegetables, &c.—*Chemisches Industrie-Blatt.*

Nitro Alizarin.—M. Caro has patented several processes for the preparation of the alizarin-orange resulting from the action of nitric acid upon alizarin. The alizarin is spread out in a thin layer upon the floor of closed chambers, and is submitted to the action of vapours of nitric acid. Another method is to dissolve the alizarin in ether, glacial acetic acid, petroleum, or nitro-benzol, and to pass a current of nitrous acid through the solution; 20 parts of the solvent are employed to 1 part of alizarin, and the current of nitrous acid is kept up until it ceases to be absorbed. The colouring matter is collected either by distilling off the solvent or by precipitation with an aqueous solution of potassa and subsequent precipitation of the salt formed with an acid. When glacial acetic acid is used as a solvent, nitric acid of sp. gr. 1·38 must be added. Sulphuric acid of sp. gr. 1·840 may likewise be used as a solvent.

Suppression of Dysentery.—Dr. Dounon.—From observations made in Cochin China, it appears that dysentery is due to certain animalculæ, *Anguillula stercoralis* and *dyssenterica*, *Anklystoma dyssenterica*, &c., introduced into the intestinal canal by means of polluted waters. The disease may be obviated by never partaking of water unless it has been previously purified by alum, or, better still, by boiling. The treatment with alum has been successfully used by the natives of Annam from time immemorial, and during six years has completely preserved the French troops in Cochin China from this dreadful scourge.

Physico-Chemical Researches on the Different Allotropic States of Hydrogen.—Dr. Donato Tommasi.—The author examines so-called electrolytic, electrised, and occluded hydrogen, and concludes that this element has no allotropic modifications.

On Black in Dyeing.—M. Moyret.—The author maintains that there is no true black in dyeing, the so-called blacks being merely dark colours. Nevertheless, the dyers of the Gobelins, when they declare that blue is a light black, are wrong as far as the colours of the present day are concerned.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 52, April, 1878.

Report presented by M. Bérard on behalf of the Committee of Chemical Arts on a Method for the Analysis of Alkaline Carbonates and Analogous Industrial Products.—MM. Delachanal and Mermet.—The process consists in oxidising the total sulphur present by means of potassium hypobromite and determining it as sulphuric acid. The carbon bisulphide in a second portion of the sample is then expelled, and the remaining sulphur oxidised and determined as before.

Determination of the Illuminating Power and of the Purity of the Coal-Gas of Paris.—M. F. Le Blanc.—This paper cannot be usefully abstracted without a reproduction of the accompanying diagrams.

No. 53, May, 1878.

Report presented by M. Davanne on behalf of the Committee of the Fine Arts on the Photographic Preparation known as the Dry Bromide of Silver Emulsion.—M. Chardon.—M. Chardon is declared to have succeeded in producing a simple and certain dry photographic process admirably adapted for use during scientific expeditions in barbarous countries. The so-called dry emulsion is a compound of collodion, containing in its pores a suitable quantity of the bromide of silver. This substance, if placed in bottles and preserved from exposure to the light, retains its properties for an indefinite time, even at very elevated temperatures. When it is required to employ the emulsion, about four grms. are dissolved in 100 c.c. of a mixture of equal parts of ether and of absolute alcohol; after agitation and twenty-four hours' contact the liquid is filtered and the plates are covered and then dried without any further preparation. When dry they are fit for use, and retain their properties for some months. The development of the impression may be effected either forthwith or a long time afterwards. Thus proofs taken at Aden have been developed at Paris.

Presence of Oxygen in Metallic Silver.—M. Dumas.—Taken from the *Comptes Rendus*, and already noticed.

Composition of Tin-Foil specially designed for Chocolate Manufactories.—MM. Charles Kopp and G. Engel.—In these tin-foils lead was found in mere traces as compared with the so-called tin which is brought in contact with articles of food in England in the shape of tinned iron. One sample, however, contained antimony to the extent of 6·111 per cent along with 0·889 per cent of arsenic!

Experiments on the Formation of Artificial Ultramarine.—M. J. F. Plicque.—Taken from the *Comptes Rendus*, and already noticed.

Bulletin de la Societe Chimique de Paris,
No. 8, April 20, 1878.

Oxidation of Ethylen.—M. Berthelot.

Persurphuric Acid.—M. Berthelot.

New Observations on the Chemical Reactions of the Effluve and on Persulphuric Acid.—M. Berthelot.

Formation of Oxygenated Water, Ozone, and Persulphuric Acid during Electrolysis.—M. Berthelot.

New Observations on the part played by Pressure in Chemical Phenomena.—M. Berthelot. — These papers have all been already noticed.

Rotatory Power of Meta-styrolen.—M. Berthelot.—The author remarks that if he insists upon the fact that styrolen is possessed of a rotatory power, it is because a theory recently proposed to explain the rotatory power of organic compounds, that of so-called "asymmetric car-

bon," regards the existence of this property as impossible in a carbide so simple as styrolen. This theory is, therefore, incompatible with experience.

Certain Reactions of Borax and of Boric Acid in presence of Mannite.—M. D. Klein.—A mixture of solutions of mannite and of alkaline or alkaline-earthy biborates, though presenting an acid reaction under certain circumstances, becomes alkaline when diluted with water.

No. 10, May 20, 1878.

Researches on Anthraflavon and Anthraxanthic Acid.—M. A. Rosenstiehl. (Second part.)—The author concludes that anthraflavon is a mixture of two isomers of alizarin, to each of which corresponds an isomer of purpurin. The author has not specially studied—*α* anthraflavon, but merely the trioxy-anthraquinon derived from it, and which has been identified with isopurpurin. Anthraflavon *β* has been identified with the anthraflavic acid of MM. Schunck and Roemer, and compared with the anthraxanthic acid of MM. Ulrich and von Perger. The two latter are secondary products of the manufacture of alizarin, that is to say, derivatives of anthracen. Oxyanthraflavon *β*, oxyanthraxanthin, and flavopurpurin are identical, and the author proposes to retain from them the name flavopurpurin. The ten bodies reviewed in the author's memoir may be reduced to five. Anthraflavon *α* (meta-benz-bioxyanthraquinon of Schunck and Roemer) isoanthraflavic acid; isopurpurin (anthrapurpurin of Perkin, Schunck, and Roemer); anthraflavon *β* and flavopurpurin. Four of these compounds are secondary products of the manufacture of alizarin, and are consequently obtained from anthracen; four of them are also procurable from oxybenzoic acid.

Aromatic Nitrosamines.—M. Otto Witt.—Not suitable for abstraction.

Remarks on the Analysis of Crude Tartars.—M. A. Scheurer-Kestner.—The tartaric acid in tartars is present as bitartrate of potassa and neutral tartrate of lime, the former of which is the principal constituent. It is generally determined by means of a standard solution of soda or potassa. Sometimes, instead, the product derived from the calcination of the tartar is titrated. Ignition transforms the titrate into carbonate, but in this case there is danger of titrating simultaneously the carbonate of lime, and of thus committing an error if it is not rectified by a special determination of the tartrate of lime. But if the tartar contains calcium sulphate, its value may be lowered by the action of the potassium carbonate upon the plaster. If the tartars are free from calcareous salts, the titration of the ignited residue gives results perfectly exact. It is not always the same with the direct titration of the acidity by means of a standard alkali. Certain tartars, and especially certain dregs of wines, contain acid organic products distinct from tartaric acid. The calcium tartrate yielding a double quantity of alkaline substance for the same proportion of tartaric acid compared with that yielded by the cream of tartar, it would be a grave error to titrate the entire product of calcination with standard acid. In this case it is proper to treat the ignited product with water till all the soluble salts are dissolved, and to titrate the solution thus obtained. This method leaves nothing to be wished if the tartar is free from plaster; in the contrary case there are formed during the solution potassium sulphate and calcium carbonate. If tartars contain plaster, it is almost impossible to determine with accuracy the relative quantities of potassium bitartrate and calcium tartrate. It is practicable only in the absence of organic acids other than tartaric. In this case, the bitartrate may be determined by the use of a standard alkaline liquid; the whole of the tartaric acid in the sample may then be determined as calcium tartrate, and the original proportion of the two salts may be found by calculation. Exact and concordant results may be obtained by the following process: The sample in question is dissolved in hydrochloric acid. The solution is filtered, mixed with calcium chloride and precipitated by caustic soda, but to avoid the possible precipitation of calcium hydrate the saturation is completed with ammonia. Instead of caustic soda ammonia may also be used for the precipitation of calcium tartrate, but in this case the quantity of hydrochloric acid employed must be limited, calcium tartrate being slightly soluble in ammonium hydrochlorate. The precipitate obtained is collected on a filter, washed, ignited, and determined by means of standard solutions.

Decomposition of Alcohol by Zinc Chloride at High Temperatures.—W. H. Greene.—The products obtained are hydrogen, hydrochloric acid, ethyl hydride, ether, water, aldehyd, and certain oily products, probably polymers of ethylen,

New Mode of Formation of Ethylic Oxide.—W. H. Greene.—On heating sodic oxide to 180° with ethyl iodide, a notable quantity of ethyl oxide is obtained.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 4, May 23, 1878.

Presence of Oxygen in the Sun.—Prof. Draper has identified in the solar spectrum no fewer than thirty of the best known rays of oxygen.

Annatto.—According to M. C. Etti, there exists in annatto a third tinctorial principle, a soft, brownish-red colouring matter, which has not yet been examined.

"Gum-ammoniac."—The gum-resin obtained from Morocco under this name, if heated in contact with potassa, yields resorcin, and a small quantity of an acid precipitable by plumbic acetate, and taking a red colour in contact with iron. Its composition is given as $C_{10}H_{10}O_6$, isomeric with hemipinic acid. The substances met with in commerce under the name of "gum-ammoniac" differ respectively in their chemical properties.—*Dr. Goldschmidt.*

No. 5, May 30, 1878.

It is announced that the coal-deposits of China are at last to be worked on a large scale, and that a railway from the mines to the sea is about to be constructed.

M. du Moncel, in reply to a letter from M. Navez, points out that a current so feeble as that of a single Daniell element, after traversing millions of kilometres of telegraphic wire can scarcely have sufficient energy to cause a plate of iron like that of the telephone to vibrate mechanically by its attraction.

Reimann's Färber Zeitung,
No. 22, 1878.

This issue contains a proposal to purify the waste waters from dye, print, and bleach works by allowing them to collect in tanks, where the various impurities may react upon each other. A process substantially the same has been successfully used in England ten years ago.

Chemiker Zeitung.
No. 22. May 29, 1878.

Polish Guano Deposits.—Exaggerated reports have been spread concerning the value of the so-called guano discovered in certain caverns between Olkusz and Ojcow. In most of these caves the deposit is not merely poor in nitrogen (0·3 per cent.), but also in phosphoric acid (2·35 to 8·65 per cent.) The bed in the Jerzmanowska cavern, near Ojcow, is the only one which appears worth working. It is poor in nitrogen,—0·4 to 0·6 per cent,—but contains, on an average, 20 per cent phosphoric acid, accompanied, however, with 10—15 per cent carbonate of lime, and about 2·2 ferric oxide and alumina. The contents of the cavern are valued at £25,000.

Vitality of Bacteria.—Concerning the recent statement of A. Frisch, that bacteria survived a temperature of

=83·5°, Dr. E. Schumacher mentions that in his experiments they were not destroyed at −113·75°.

Distinction of Colours by Artificial Light.—The light of Swedish safety-matches is sufficiently white for recognising the difference between greens and pale blues.

Cleansing Glass Vessels.—For quickly and perfectly cleansing glass vessels, especially if soiled with fatty matters Walz recommends the application of a concentrated solution of potassium permanganate, mixed with a few drops of hydrochloric acid.

Sugars Tinted with Ultramarine.—If such sugars are heated along with the juices of fruits, the ultramarine is decomposed with evolution of sulphuretted hydrogen.

Detection of Alcohol in Presence of Methylic Spirit (Wood Naphtha).—The liquid to be tested is distilled with sulphuric acid, the distillate mixed with potassium permanganate and sulphuric acid, any turbidity being removed by means of sodium hyposulphite, and a very dilute solution of magenta is added drop by drop. If alcohol was present, the red colour of the magenta is changed to a violet, by the acetaldehyd which is formed. —*Zeitschrift f. Anal. Chemie.*

Separation of Nickel and Iron.—The process depends on the insolubility of ferric phosphate in acetic acid, in presence of sodium phosphate in excess, whilst nickelous phosphate is soluble. The hot solution of the two metals containing free acetic acid is mixed with sodium phosphate, the ferric precipitate is removed by filtration; from the filtrate phosphate of nickel is thrown down by the addition of potassa, the precipitate is dissolved in sulphuric acid, the solution is rendered alkaline, and the nickel precipitated by the galvanic current. The process is only applicable where the nickel does not exceed 3 per cent.—*Zeitschrift f. Anal. Chemie.*

MISCELLANEOUS.

University of London.—The following is a list of the candidates who have passed the recent D.Sc. Examinations:—Branch IV., Inorganic Chemistry: P. P. Bedson, Owens College; J. K. Crow, Owens College. Branch V., Organic Chemistry: R. H. Jude, Christ's College, Camb. Branch VIII., Physical Optics, Heat, Acoustics (treated experimentally): S. P. Thompson, B.A., private study. Branch XIV., Geology: C. Callaway, M.A., private study; R. D. Roberts, Clare College, Camb.

Edison's Instrument for Measuring the Heat of Heavenly Bodies—Improvements in the Telephone. —Mr. Edison was recently visited, at his home in Menlo Park, by Profs. Brackett and Young, of Princeton College, and Prof. Barker, of the University of Pennsylvania, who were desirous of examining his instrument for measuring heat. Mr. Edison has made several experiments with this apparatus, and has succeeded in measuring the fifty-thousandth part of a degree of heat. Prof. Young and Prof. Brackett will go to Colorado to observe the solar eclipse, and the usefulness of this instrument for measuring the heat of the heavenly bodies will then be tested for the first time. Mr. Edison has also been working diligently at his telephone. He has lately perfected the "receiver" of his telephone so that words spoken at a distance of 100 feet from the instrument have been distinctly heard 30 rods away. He recently placed a telephone containing the improved "receiver" in his laboratory, and connected it in the usual manner with another one in his house, which is more than 30 rods distant. The instrument in the laboratory was placed at the end of the room, and Mr. Edison retired to the other end, and his words—spoken in an ordinary conversational tone—were distinctly heard in the other telephone at his residence. One difficulty met with in the experiment was that the other sounds in the laboratory were also transmitted through the instruments, but they did not destroy the sound of the inventor's voice. The resistance thus overcome by the sound was equal to that encountered in traversing 100 miles of wire when the words are spoken directly into the "receiver."—*New York Daily Tribune.*

NOTES AND QUERIES.

Sulphate of Iodo-Quinine.—Would some reader kindly describe the method of preparing above for use as artificial tourmalines?—C. J. Leaper.

Molybdate of Ammonia.—Would some reader kindly describe Eggertz's method of preparing a solution of the above in nitric acid as a test for phosphoric acid?—C. J. Leaper.

Liquid Lighter than Water, &c.—Can any of your correspondents name me a substance with the following properties, viz:—Liquid, lighter than water, not volatile, and insoluble in water and in bisulphide of carbon?—E. R.

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c

Now ready, No. LIX., *July*, 1878, price 5s.

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Notices of Scientific Works, Scientific Notes, &c.

London: 3, Horse-Shoe Court, Ludgate Hill, E.C.

MANCHESTER CORPORATION GAS-WORKS.

AMMONIACAL LIQUOR.

The Gas Committee of the Corporation of Manchester are prepared to RECEIVE TENDERS for the PURCHASE of the AMMONIACAL LIQUOR to be produced at their Gaythorn and Rochdale Road Works during a period of one or more years, commencing from the 1st day of January, 1880. In addition to tenders for the purchase of the liquor in its crude state, the Committee will also be prepared to consider tenders for its disposal, either by manufacture into sulphate of ammonia at the above-mentioned works on their behalf, or in any other manner. The Committee reserve to themselves the option of accepting the offer the terms of which they deem most advantageous. They do not bind themselves to accept the highest or any tender. Sealed tenders, addressed to the Chairman of the Gas Committee, Town Hall, and endorsed "Tender for Ammoniacal Liquor," must be delivered at these offices on or before Tuesday, the 1st day of October next.—Forms of tender and further particulars can be obtained on application to Mr. George B. Jackson, at the Gas Offices.—By order of the Gas Committee,

JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 31st May, 1878.

MANCHESTER CORPORATION GAS-WORKS.—AMMONIACAL LIQUOR.—The TIME for RECEIVING TENDERS has been EXTENDED from the 1st of August to the 1st of October next.—By order of the Gas Committee,

JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 5th July, 1878.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c., &c. Prices and samples on Application.

TESTIMONIAL.

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years, during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

THE CHEMICAL NEWS.

Vol. XXXVIII. No. 973.

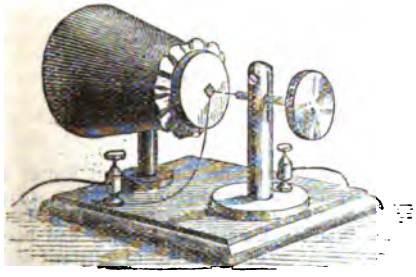
A SINGING TELEPHONE.

By HENRY MORTON, Ph.D.,
President of the Stevens Institute of Technology, Hoboken, N.J.

In connection with the very general interest in the telephone, and the demand for some instrument which might serve as a means of illustration for lectures before large audiences, I was recently led to make some experiments in the direction of developing a singing telephone, simple and inexpensive in its construction, and yet capable of producing musical sounds loud enough to fill the largest lecture halls. In carrying out this object I was assisted by the following gentlemen, graduates of or students in the Stevens Institute of Technology:—Mr. Wm. E. Geyer, Mr. Brown Ayres, and Mr. Henry A. Beckmeyer.

Without attempting to give the various experiments and modifications, I will simply describe the instrument as it was finally perfected, and has been manufactured since by Messrs. Geo. Wale and Co., Philosophical Instrument Makers, of this place.

The transmitting apparatus consists of a hollow truncated cone, whose smaller end is closed by a diaphragm of metal, paper, or thin sheet rubber, and of a platinum



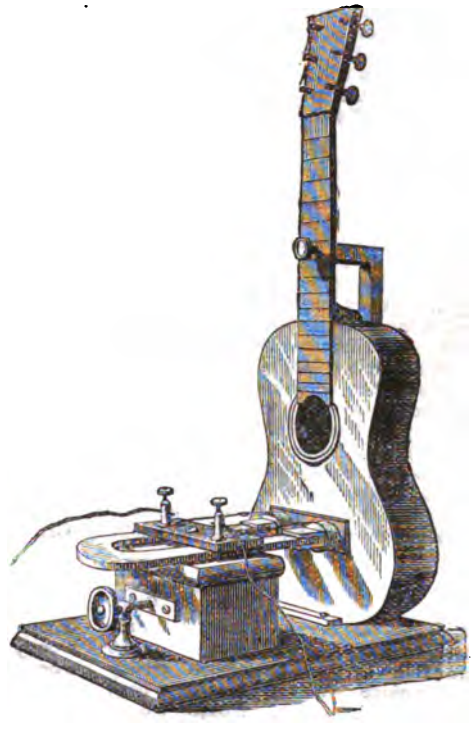
pointed screw, so supported as to make contact with the centre of this diaphragm. The centre of the diaphragm is provided with a plate of platinum connected if necessary by a wire with a binding-post.

On singing into the open end of the cone the vibrations caused in the diaphragm occasion corresponding ruptures in the circuit at the point of contact of the central platinum plate with the platinum pointed screw. The best effect is obtained by closing part of the cone with the hand and singing into the remaining opening with the mouth closely applied. The contact of the screw and plate should also be as *strong* as can be obtained on trial without loss of effect.

The receiving apparatus, shown in the accompanying figure, consists of a powerful steel horseshoe-magnet supported horizontally on a sliding block provided with an adjusting screw. The poles of this magnet are provided with soft iron caps terminating in pins or cylindrical poles, on which are placed flat spools of very fine wire. These spools have each a resistance of about 100 ohms. Opposite to these poles is firmly supported a guitar, whose springs have been removed, and to whose bridge had been attached a plate of soft iron acting as an armature to the magnet.

When in use the magnet is so adjusted by means of the screw at the rear that its soft iron pins or poles are very close to the armature of the guitar. A battery of six to twelve Leclanché cells being placed in circuit, and a performer singing into the cone of the transmitter, the fluctuations in the attraction of the armature by the magnet will then cause the guitar to emit musical sounds of remarkable intensity. One of these instruments was lately used by Dr. Geo. F. Barker (of the University of Pennsylvania) in a lecture delivered by him in the Opera House at Philadelphia, and its sound, clear and flute-like, was heard even *out into the street*, though this is a building seating over three thousand persons.

If the current interrupted by the transmitter is made to pass through the primary of an induction-coil, and the secondary current of the same is then carried to the receiver at the distant place, two small cells of a Grove battery will produce the most intense sounds, and the current



may be caused to traverse the bodies of several persons, and will yet, without occasioning any painful shock, produce music in the guitar loud enough to be heard in every part of the largest auditorium.

A very convenient battery for use with these instruments has been made by Messrs. Geo. Wale and Co. from glass specimen tubes ¾ inch in diameter and 4 inches high, into which are introduced in a convenient manner strips of carbon and zinc. The exciting fluid may be dilute sulphuric acid, or a solution of Glauber salt, or of sal-ammoniac.

Nitro-derivatives of Alizarin.—Samuel Grawitz.—The property of alizarin of yielding nitro-derivatives is a fact which the author believes he was the first to point out in his patent for the production of artificial purpurin. One and the same alizarin can furnish two distinct amide-derivatives, by the reduction of the nitro-derivative, the one soluble in alkalies, and the other insoluble. If alizarin is the phthalic ether of oxyphenol or its isomer, it is natural that all the facts in the history of the nitro- and amido-derivatives of phenol should recur among the nitro- and amido-derivatives of alizarin. The author pointed out two years ago an oxidation-derivative of alizarin yielding blue lakes.—*Bulletin de la Soc. Chimique de Paris.*

ON THE

COMPOSITION OF THE RIVERS PARANA AND URUGUAY.

By JOHN J. J. KYLE, Buenos Ayres.

For some years I have had occasion to analyse the water supplied to the City of Buenos Ayres, and in the year 1872 was employed to examine the water of the Rio de la Plata and of the River Parana, its principal tributary. The object of the latter investigation was to determine the most suitable locality whence to draw the increased supply, which forms part of the City of Buenos Ayres Improvement Scheme, now being carried out under the direction of the eminent engineer, Mr. J. F. Bateman, F.R.S. I have very recently had an opportunity of analysing the water of the other great river, the Uruguay, which, together with the Parana, supplies the enormous volume of water, estimated at 700,000 cubic feet per second of time, which the Rio de la Plata pours into the Atlantic Ocean.

I have not been able to find any reference to the composition of these great South American Rivers in any of the standard works on chemistry, and for this reason I take the present opportunity of communicating a few particulars, which appear to be of some interest.

The Rio de la Plata, or River Plate, is in reality the estuary of the Rivers Parana and Uruguay; is characterised by its muddy appearance, and always contains in suspension a considerable amount of "colloid" clay. This suspended clay is almost exclusively derived from the immense territory drained by the River Parana. The Uruguay is a river remarkable for its transparency and freedom from suspended matters. The following table shows the proportion and composition of the residue yielded by 1000 c.c. of each of the three waters—the River Plate, at about five miles above the city of Buenos Ayres; the Parana, at about five miles above its termination in the Plate; and the Uruguay, in the middle of its stream in front of the town of Salto in the Republic of Uruguay.

	River Plate. Grm.	River Parana. Grm.	River Uruguay. Grm.
Sodic oxide	0·0212	0·0189	0·0020
Potassic oxide..	0·0034	0·0046	0·0015
Calcic oxide	0·0078	0·0095	0·0055
Magnesic oxide	0·0050	0·0043	0·0019
Ferric oxide	0·0040	0·0030	—
Aluminic oxide	0·0060	0·0030	—
Silicic acid (SiO_2)	0·0193	0·0194	0·0185
Sulphuric acid (SO_3) ..	0·0058	0·0079	0·0013
Carbonic acid (CO_2) ..	0·0116	0·0122	0·0071
Chlorine	0·0114	0·0149	0·000247
Nitric acid (N_2O_5)	—	—	0·0019
Organic matters	0·0100 ?	0·0106 ?	traces
	0·1055	0·1083	0·039947
Determined directly ..	0·1000	0·1000	0·039500

The three waters were examined by Wanklyn's process, and yielded per litre:—

	River Plate. M.grms.	River Parana. M.grms.	River Uruguay. M.grms.
Free ammonia..	0·07	0·16	0·07
Albuminoid ammonia	0·24	0·24	0·10
Hardness (1°=0·01 grm. per litre of $CaCO_3$) .. ., ..	4·00°	4·50°	2·25°

The minute quantities of nitric acid were not determined in the Plate and Parana waters; in the Uruguay water it was estimated by Thorpe's reduction method. Part of the silica and all the alumina belong to the clay which, as already stated, is suspended in the first two waters, and remains in this condition for many weeks. The water of both the Plate and Parana always yields, by Wanklyn's ammonia process, a very large amount of albuminoid ammonia, derived chiefly, I believe, from vegetable organic matters partly in solution and partly adherent to the suspended clay. In spite of this and its opaline, sometimes even muddy, appearance, the Plate water is highly esteemed as a drinking-water.

Beyond this the composition of these two rivers does not call for any further observations. The water of the River Uruguay is, however, in some respects very remarkable. It is probably one of the purest river waters in the world, containing rather less than 4 parts of solid matter per 100,000. It is almost free from chlorides: the determination of chlorine, made with every possible care, gave rather less than one-fourth of a milligrm. per litre, and this, be it remembered, at a distance of say 500 miles from its source.

Still more noteworthy, in my opinion, is the fact that about 46 per cent of the total solid matter consists of soluble silica, not suspended as in the other two rivers. A small proportion exists probably as alkaline silicate, but the greater part is undoubtedly present as hydrated silicic acid. In this circumstance may be found an explanation of the petrifying properties attributed to the water of the Uruguay. On one occasion a cart-wheel was fished up from its bed completely converted into stone. A considerable export trade in agates is carried on by the inhabitants on the Uruguayan shores of this great river, and the stones from the Uruguay are, I believe, those most esteemed by European lapidaries. The free silicic acid dissolved by this river among the mountains of Santa Catherina, in Brazil, is probably the raw material out of which are elaborated the agate mortars so invaluble to every analytical chemist.

National College, Buenos Ayres, June, 1878.

COMPOSITION OF POTATOES.

At a meeting of the Scientific Committee, Royal Horticultural Society, South Kensington, March 5, 1878, Dr. Gilbert made some very interesting remarks on this subject. He said that Mr. Lawes and himself had been for two years experimenting on the effects of different manures on the potato, and they had obtained a variation in the amount of produce from something over three tons without manure to nearly nine tons with the highest manure. Samples of the different crops had been analysed in the usual way, and a great difference in the composition of the tubers was found. There was a difference of several units per cent in the amount of dry or solid matter; there was about one and a third time as much mineral matter in some as in others; and there was nearly twice as much nitrogen in some as in others.

It occurred to them that it would be interesting also to examine the tubers somewhat in the way adopted in the case of some root crops, such as sugar-beet; that is, to express and determine the composition of the juice.

It was found that by far the largest proportion of both the mineral matter and the nitrogen of the tuber existed in the clear filtered juice; and there was as striking a variation in the percentage of these in the juice as in the whole tubers, depending on the character of the manure and on the amount of crop. It was remarkable, too, that some of the largest crops, which, judging from the withered condition of the tops, must be considered fairly ripe, nevertheless contained a juice relatively very rich in nitrogen.

His special object in referring to these experiments was, however, to call the attention of the Committee to some results which they had obtained with diseased potatoes. Already the Rev. J. H. Jellett* had examined the juice, or

* *Proceedings of the Royal Irish Academy*, May 22, 1876.

rather the extract, of sound potatoes, of the apparently sound part of diseased potatoes, and of the discoloured part of diseased potatoes. He had found a considerable development of sugar in the white part of the diseased tubers. He also determined the amount of nitrogen in the dry matter of similar specimens, and found it to be greater in that of the apparently sound part of diseased potatoes than in that of sound potatoes, and also greater in the diseased part, but not so great as in the apparently sound part.

At Rothamsted they had experimented rather differently. They had determined the nitrogen and the mineral matter in the sound whole tubers and in the diseased whole tubers; in the juice of the sound potatoes, in that of the white part of the diseased potatoes, and in that of the black part of the diseased potatoes. They had also determined them in the washed or exhausted solid matter or "mark" of the white part and of the black part of diseased tubers.

In accordance with Prof. Jellett's results they found a higher percentage of nitrogen in the dry substance of the diseased than of the sound potatoes; but, calculating the quantity upon the fresh tubers, they did not find evidence that there was an actually greater amount of nitrogen in the diseased potatoes.

The most interesting point in their results was, however, that whilst the juice of the white portion of the diseased potatoes contained approximately the same amount of nitrogen as that of corresponding sound potatoes, the juice of the diseased portion contained very much less; in fact, only about one-half or two-thirds as much. On the other hand, the washed or exhausted "mark" of the white portion contained a very small amount of nitrogen, whilst that of the black or diseased portion contained very much more, in some cases four or five times as much as the "mark" of the white portion. It was also found that the amount of mineral matter was much higher in the juice of the white than in that of the diseased portion, but much lower in the "mark" of the white than in that of the discoloured portion. It was obvious from these facts that the juice had suffered exhaustion of much of both its nitrogen and its mineral matter in the development of the fungus. The sugar, itself the result of diseased action, probably also contributed to the same end.

PHOSPHORUS IN CLEVELAND IRONSTONE AND IN IRON.*

By J. E. STEAD.

(Continued from p. 18)

The Effect, Physically and Chemically Considered, which Phosphorus has on Pig Metal.

Physical Properties.

FROM what has been already stated, it must be clear that phosphorus makes pig metal brittle, and this is a fact so well known that I need not further discuss the question.

Silicon, we all know, when present in Cleveland pig to the extent of about 5 per cent, causes it to crystallise on cooling, so as to present when cold, on the fractured surface, a glazed appearance.

The result of a large number of analyses has proved that this iron cannot contain more than 5 per cent of silicon without having this peculiar texture. It is different, however, with metal containing little or no phosphorus. Bessemer pig-iron is often produced, containing above 5 per cent silicon, and yet has shown no glazed appearance or fracture. The sample placed before you, containing nearly 7 per cent, is an instance.

It seems from this, that, as a considerable quantity of iron is in combination with phosphorus in Cleveland iron, there is less iron remaining capable of taking up silicon than is the case where no phosphorus is present; consequently less silicon will be required to give to the smaller proportion of iron the conditions necessary for the production of glazed iron.

Chemical Properties.

When sulphur is added to fluid metal—which, under ordinary circumstances, would assume a grey fracture when cooled and broken—the sulphurised iron when cold will present a mottled or white fracture. In other words, sulphur prevents the separation of carbon as graphite.

In order to ascertain if phosphorus has a similar action, the following experiments were made. Four moulds in sand, each of the same size, were made. On the bottom of two of these, small sticks of phosphorus were placed, after which all the moulds were filled with molten Cleveland iron.

A considerable amount of phosphorus was vapourised and burnt at the top of the moulds in which it was placed.

After cooling, the castings were broken. Both of the samples containing excess of phosphorus exhibited closer fractured surfaces than those to which it was not added, but they had no mottled appearance. On testing for phosphorus and combined carbon the following results were obtained:—

	Metal without phosphorus added.	
Combined carbon ..	0·60 per cent ..	0·61 per cent
Phosphorus..	1·46 „ ..	1·46 „
	Metal to which phosphorus was added.	
Combined carbon ..	0·73 per cent ..	0·73 per cent
Phosphorus..	1·71 „ ..	1·70 „

From these results it will be seen that 0·13 per cent of carbon has been prevented from assuming the graphoidal state by the action of 0·25 per cent of phosphorus. It might be objected that the volatilisation of a portion of the phosphorus introduced into the moulds would chill the metal and cause it to set more quickly, and that this might account for the difference in the proportions of combined carbon, but it is a fact that the samples containing the most phosphorus were the last to assume the solid state, so that the objection must cease. The effect of phosphorus compared with sulphur is, however, very small, and would not affect materially the quality of the iron or pig in this direction if increased in considerable quantity.

Methods of Removing Phosphorus from Pig Metal.

I have made considerable research in this direction, but shall not be able to give all the results in the present paper as time will not permit. I shall therefore confine myself to some features of the common method of purification by oxide of iron.

The action of oxide of iron is well known, but it has frequently been supposed that oxide of iron, without the aid of mechanical power, has very little action, and that the work a puddler gives to the metal has some important action in removing phosphorus independent of the oxide of iron.

By the results obtained from numerous experiments, it has been clearly proved, that mechanical power, whether it be in the force of the refining blast, the motion of the puddler's bar, or the revolving of the rotary puddling machine, is simply the means by which the molten iron is brought into intimate contact with the fluid or semi-fluid oxide of iron. The removal of phosphorus depends entirely on the action of these, and mechanical force is no more concerned in the chemical action between cinder and phosphide of iron than the men who convey the ore to blast-furnaces have to do with the reactions which take place within. The action is due to fluid or semi-fluid oxide of iron.

By the results which follow it will be seen that, when

* A Paper read before the Cleveland Institution of Engineers.

the puddling process is conducted at a very low temperature, or when the cinder is run out of the furnace before the phosphorus is removed, the puddled bar produced is high in phosphorus. On the other hand, when a high temperature is maintained a very excellent quality of bar is produced.

The reason for these facts must be clear. In the first instance the temperature is not high enough to liquefy the necessary amount of cinder required for the purification of the metal, and, as a consequence, there is left an impure iron. Again, when the cinder is removed from the semi-purified iron, the purifying agent being taken away, the removal of phosphorus is retarded and a phosphuretted iron is produced. The following results show that what has been stated is correct, viz.:—

No. 1.

Cleveland iron puddled in an ordinary furnace. Conditions—normal:

	Metal charged to furnace.	Metal just before boil.	Puddled bar iron.
Phosphorus	1·54 per cent	0·73 per cent	0·306 per cent

No. 2.

Puddled at very low temperature:

	Metal.	Puddled bar.
Phosphorus	1·54	0·52 per cent

No. 3.

(Bleeding.) Cinder run out before boiling;

	Metal	Metal just before boiling.	Puddled bars.
Phosphorus	1·54 per cent	0·65 per cent	0·448 per cent

On the other hand, when the temperature is very great, an abundant supply of oxide of iron is melted, and this acting on every part of the iron presented to it by mechanical means the metal is thoroughly purified.

This will be seen by the result of an experiment made in the same furnace in which the former experiments were carried out.

Metal Puddled at a High Temperature.

	Metal.	Metal just before boiling.	Bar iron.
Phosphorus	1·54 per cent	0·18 per cent	0·09 per cent

Phosphoric acid in cinder, 4·2 per cent.

The following results were obtained from an analysis of iron made in a Danks furnace at the works of Messrs. Hopkins, Gilkes, and Co., who have kindly permitted me to lay them before you in this paper. The temperature of furnace was high.

	Metal.	Metal just before boiling.	Bar iron.
Phosphorus	1·80 per cent	0·21 per cent	0·17 per cent

Phosphoric acid in cinder, 10 per cent.

The following experiments, made by the direction of Mr. Edward Williams, also show the powerful action of fluid oxide of iron.

Fluid Cleveland iron was poured into crucibles containing cinder, also in a fluid state. The crucibles with contents, after having been carefully covered, were violently shaken for about a quarter of a minute. After this treatment the metal, still in a fluid state, was poured out from each of the vessels into moulds, and allowed to set.

On analysis the refined iron was found to contain, viz.:

	I.	II.	III.
Carbon ..	1·80 per cent	2·40 per cent	3·00 per cent
Silicon ..	0·04 ,,	trace	trace
Phosphorus	0·13 ,,	0·13 ,,	0·04 ,,

The cinder used in No. 1 and 2 experiments consisted of mill tap, for No. 3 a mixture of mill scale with 20 per cent of sand.

It is clear that the agitation to which the metal was subjected was simply a means of exposing every particle of its mass to the action of fluid oxide of iron, and we have no hesitation in saying that could we so subdivide, say, a ton of Cleveland metal, in such a way as to expose every molecule of its mass to the action of rich oxide of iron in a fluid state, the removal of the phosphorus would be effected instantly.

So far we have only considered the changes which take place between oxide of iron and metal, at the highest temperatures attainable in puddling furnaces. We now pass on to consider the reactions, which are effected at excessively high temperatures.

Iron, compared relatively with oxygen, has a much greater attraction for phosphorus at high than at low temperatures; whereas at low temperatures oxygen has the greater attraction. A striking instance of this will be seen from the following results obtained in a Bessemer converter.

A charge of 6 tons was overblown for about 15 minutes. A large amount of oxide of iron was produced in consequence. In fact, throughout the entire mass, where the air came in contact with the iron, rich oxides of iron must have been formed, which, I naturally thought at the time would remove all the phosphorus from the iron present to the extent of about 0·10 per cent. It was, however, found that such was not the case, as will be seen by the analysis below, viz.:

Protoxide of iron	47·68 per cent
Peroxide of iron	6·87 ,,
Protoxide of manganese ..	3·47 ,,
Lime	0·52 ,,
Magnesia	1·05 ,,
Silica	39·00 ,,
Sulphur	0·09 ,,
Phosphoric acid	nil ,,
Alumina	1·30 ,,
	99·98 ,,
Metallic iron	41·89 ,,

The phosphorus was evidently so strongly attracted by the iron that even oxide of iron failed to remove it.

In order to ascertain if this cinder would remove phosphorus from iron at a lower temperature, lumps of it were stirred about in fluid Cleveland iron. The metal was then poured out, and an analysis made for phosphorus. The metal result showed that 50 per cent had been removed, clearly proving that its incompetency to remove the phosphorus in the Bessemer converter was due to the excessively high temperature.

Iron Heated with Phosphoric Acid.

Pure iron at red heat has no power to decompose phosphoric acid, but, if heated to its fusion point, the acid is rapidly decomposed. An experiment, in which pure iron was fused in a crucible with phosphorus pentoxide, P_2O_5, gave a very fusible button of phosphide of iron, containing, viz.:—

Iron	85
Phosphorus	15
	100

The result clearly shows that phosphoric acid is decomposed by iron, phosphide and oxide of iron being produced.

The next point was to ascertain whether or not pure iron would decompose phosphoric acid when in combination with iron oxide. For this end pure iron was fused with puddlers' tap cinder, containing above 4 per cent of phosphoric acid. The button produced contained =2·12 per cent. The experiment was repeated with the

same results. The buttons in both cases lost in weight about 20 per cent during the treatment, clearly proving the absence of reducing agents, such as carbon or carbonic oxide. Pure iron was next fused with phosphate of iron. The metal, after fusion, contained 2·68 per cent of phosphorus.

Cleveland pig-iron in fine powder was mixed with pure oxide of iron, and exposed to a very high temperature, so as to fuse the spongy iron produced. The metal before and after the treatment contained, viz.:—

	Before.	After.
Carbon	3·50 per cent ..	trace
Silicon	2·80 „ ..	trace
Phosphorus ..	1·50 „ ..	1·28 per cent

It must be clear that, during fusion, the phosphorus would be removed at first when the temperature was not excessive, and that it had been reduced again from the cinder when the iron became extremely hot, by the reducing action of the iron itself.

On testing the cinders from these experiments, they were all found to be nearly saturated with silica, which had been dissolved from the sides of the silicious crucibles. We therefore must consider these results to be due to the combined action of phosphate of iron and silica on pure iron, and not to that of phosphate of iron *per se*.

We know that silica displaces phosphoric acid from its compounds, when fused with them; and it is probable that the silica, which passed into the cinder, liberated the phosphoric acid, which, in its free state, would be decomposed by iron.

As it is a difficult matter to find any crucibles made of a substance which has no action on oxide of iron or is unaffected by the oxide, the following experiment was made:—One end of a piece of pure wire was coated with phosphate of iron. The other end was supported by hand, and by means of an oxyhydrogen jet the end coated with phosphate was fused completely. By this method the two substances were fused together without the aid of a direct support. A considerable amount of the iron was burnt away, but the minute globule of iron not weighing more than 0·10 gramme, on analysis, distinctly showed the presence of phosphorus.

We now turn to the consideration of the nature of the action between oxide and phosphide of iron.

In order to ascertain whether this is a physical action (in which the oxide or cinder simply washes out the phosphide) or a chemical one (by which the phosphorus is oxidised by the oxygen of the oxide, the following experiment was made.

Two grammes of phosphide of iron were fused under a thick layer of iron oxide, consisting chiefly of protoxide, for one hour. Now, if the action be a purely physical one, in which the phosphide is bodily removed, and retained in the slag or cinder as such, our button after fusion should weigh less than before. The weight, however, was greater, which fact at once leads us to decide that the action is not physical but chemical.

The button weighed 2·3 grammes or 15 per cent greater than before. They had the following-mentioned composition, viz.:

	Metal before	Metal after.
Iron ..	.. 1·768 %	2·162 %
Phosphorus	.. 0·232	0·138
	2·000	2·300

It will at once be seen that there has been a loss of 0·232—0·138 = 0·094 grammes of phosphorus, and a gain of 2·162 − 1·768 = 0·394 gramme of iron. That is to say, 0·094 of phosphorus has taken the oxygen from 0·394 parts of iron, existing as oxide in the cinder, to produce phosphoric acid. Each unit of phosphorus has precipitated 4·2 units of iron, calculating from theory expressed by the chemical expression

$$P_2 + 5FeO = P_2O_5 + 5Fe.$$

One of phosphorus should be equal to 4·5 parts of iron, which is very near that obtained by experiment.

Phosphorus in Bar Iron.

This subject I cannot treat at length in this paper, as I have already exceeded the time at my disposal.

All bar iron made from phosphatic pig-iron contains posphorus in two conditions, one in combination with the iron itself, producing, if in large quantity, "cold-shortness;" the other in cinder, wrapped up between the particles of iron, exists as phosphoric acid and has no injurious effect on the bar.

It has long been a difficulty with chemists to estimate these quantities, so as to be able to state what proportion of the phosphorus, in any sample they may test, is combined with the iron. I have given a considerable amount of attention to this matter, and, I believe, with success. Without describing the method adopted, which would be of little interest to the members of this Institute, I shall give the results obtained by its use.

The amount of phosphorus found in puddled bar made in Cleveland is well known to be between 0·30 and 0·40 per cent, or from 20 to 25 per cent of that in the pig-iron.

The proportion existing as phosphoric acid in the cinder varies between 0·05 and 0·15 per cent, just as the proportion of cinder varies which is not squeezed out of the bar.

Assuming that 2, 3, 4, and 5 per cent of cinder containing 2·5 per cent of phosphorus is left respectively in four different bars, it will be clear that we should have, respectively 0·05 per cent, 0·075 per cent, 0·10 per cent, and 0·125 per cent phosphorus, not in an injurious state of combination with the iron, which is capable of being simply squeezed out by the rolls after piling, heating, and rolling. This is shown to take place from the following results obtained by twice piling and rolling No. 2 ordinary bar iron made from Cleveland pig.

After the second rolling, the No. 4 bar produced was excellent fibrous iron and very soft, whereas, before the treatment it was in great part crystalline and hard. These samples of Nos. 2, 3, and 4 bars were with the following results:—

	Phosphorus combined with iron.	Phosphorus in cinder enclosed.	Phosphorus total.
No. 2 ..	0·243 %	0·087 %	0·33 %
„ 3 ..	0·130	0·110	0·24
„ 4 ..	0·071	0·149	0·22

From this result we see that a considerable amount of phosphorus is removed by simply heating and rolling iron containing it; we also see that it is oxidised and removed from the iron, which of course accounts for the great improvement in the quality of the bar.

Before concluding, by the kind permission of Messrs. Hopkins, Gilkes, and Co., I have pleasure in laying before you three analyses of finished bars made from Cleveland iron, puddled in the Danks furnaces at the Tees Side Iron Works, which prove that our iron, although containing rather more phosphorus than we care for, is capable of being almost freed from it.

	I.	II.	III.
Carbon	0·080 %	0·110 %	0·160 %
Silicon	0·092	0·046	0·040
Sulphur	0·012	0·016	0·012
Phosphorus ..	0·110	0·060	0·073

Phosphorus.

	Combined with iron.	In cinder.	Total.
1 ..	0·057 %	0·063 %	0·110 %
2 ..	0·023	0·037	0·069
3 ..	0·034	0·039	0·073

Without making any comparisons, I think we all must agree that better iron than this it would be difficult to find.

(To be continued).

PROCEEDINGS OF SOCIETIES.

EDINBURGH UNIVERSITY CHEMICAL SOCIETY.

Tenth Meeting, May 29, 1878.

JOHN GIBSON, Ph.D., F.R.S.E., in the Chair.

A PAPER was read by Mr. GEORGE MACGOWAN, F.R.S.E., on "*The Action of the Chlorides of Iodine on Ethylen and Acetylen.*" The following were the chief points in the paper:—(1) The formation (in theoretical quantity) of chloride and chlor-iodide of ethylen, on passing the latter slowly over pure iodine-trichloride at 0° C. (2) The formation of the new compound acetylen chlor-iodide (C_2H_2ICl) by passing acetylen through a solution of iodine mono-chloride in ether at 0° C. (3) The author failed to obtain any acetylen cyanogen compounds.

CORRESPONDENCE.

ABSORPTION OF SUGAR BY BONE-CHAR.

To the Editor of the Chemical News.

SIR,—In addition to the authorities quoted in a former communication upon the absorption of sugar by bone-char I cite the following:—

An article in the *Sugar Cane*, Jan. 1, 1872, entitled "The Analysis of Sugar and Molasses." The author says, in speaking of filtration over cool, "the first filtered portion must be rejected, because the density is altered."

In the *Zeitschrift für Zucker-industrie*, 1872, p. 259, is an article by E. Sostmann, upon the determination of sugar in bone-char that has been used. He says, "Es fast unmöglich is durch reines heisses Wasser Allen Zucker aus der Kohle Auszussüssen," and goes on to give his method of treatment with a solution of caustic alkali.

Wurtz, "Dict. de Chimie," art. "Sucre," says, in speaking of the decolourisation of a solution of molasses, "Les so premiers centimètres cubes filtrés, sont écartés, leur titre étaut faussé, par l'action initiale du noir."

In "Muspratt-Stohman's Chemistry," 3rd edition (German), a list of authorities is cited—under v. Knochenkole—upon the absorption power of bone-char for sugar. Scheibler and Walberg are quoted as having closely investigated the subject.

Scheibler found that 5·5 grms. of bone-char added to a 50 c.c. solution of 13·024 grms. of sugar made the results on an average 0·4 per cent too low.

Walberg's work and tables of absorption are very striking.

Payen, "Precis de Chimie Industrielle," English translation, p. 876, says, The use of the charcoal is to be avoided as much as possible, because it absorbs a portion of the sugar as well as colouring matters.

In "Watts's Dictionary, vol. i., p. 742, after speaking of the power possessed by bone-char of absorbing organic substances, this caution is given:—"It is important to bear this in mind [viz., the absorbing power of sugar] in analysing liquids which have been decolourised by animal charcoal, as many of the substances originally contained in the solution may have been carried down by the charcoal."

The same work, "Watts's Dict.," under v. Sugar, gives directions for rejecting the first fourth of the liquid which runs over the cool.

I have quoted above such books only as happened to be at hand in my laboratory, and there appears to be an almost absolute consensus of authorities on this point.

Although further research would seem to be a waste of time, still, to make assurance more sure, I m ade the following experiments.

A.—A sample of cane sugar was polarised in a Ventzke instrument with a good field and delicate tints, so that two observers could generally agree to 1-10 of a degree—

P = 99·50

The above solution—which had simply been filtered through paper—was run over a little fine *dry* char thrown on a dry filter.

P, first running = 99·00
P, second ,, = 99·20
P, third ,, = 99·40

The solution was exhausted before enough had been run over to get a solution which would test 99·50.

B.—A half weight of nearly pure sugar for the Ventzke instrument was weighed, dissolved in 100 c.c. of distilled water, and the solution tested—

P = 49·80.

A little perfectly dry char was introduced into the solution, the flask corked, and another test made at the end of twenty minutes—

P = 48·40, or a loss of 1·40 per cent.

C.—A sample of centrifugal sugar was tested—

P = 95·30.

A little of this solution was run over a small amount of dry fine char and immediately tested—

P = 95·00.

D.—About 50 c.c. of the original solution was shaken up in a flask with a little char for ten minutes. The solution was then re-tested—

P = 94·60.

Another portion which had remained longer in the char was tested—

P = 94·50.

E.—The char used in the above experiments was the fine dry char in daily use in my laboratory, but for fear it might be open to criticism I prepared some myself by drying fine sifting four and a half hours at 180° C., and bottling it immediately. With this new lot the following trials were made, viz.:

F.—A sugar solution was polarised by myself and my assistant. Our readings are given as A and B.

	A.	B.	Average.
P	80·70	80·80	80·75

30 c.c. of this solution were introduced into a dry flask with 7 c.c. of the new char. At the end of thirty minutes the solution was filtered and re-tested.

	A.	B.	Average.
P	80·20	80·20	80·20

Here was a loss of ½ per cent.

Half the original solution (which had been kept in a stoppered flask) was now filtered through a dry filter, so that it might have the same exposure to the air, &c., as the char-treated solution, which was now run again over the char on the filter, both filtrations going on simultaneously. The solutions were then re-tested—

	A	B.	Average.
Original solution P =	80·70	80·70	80·70
Char treated ,, P =	80·10	80·10	80·10

Here was a loss of 6-10ths per cent.

G.—A sugar solution polarising 88·40 was run once over the new char and then tested.

P = 87·60.

Here was a loss of 8-10ths per cent.

H.—A sugar solution polarising 96·50 was shaken up with a little of the new lot of char, and re-tested at the end of one hour.

P = 95·90.

Here was a loss of 6-10ths per eent.

Some other tests were made which simply amounted to a repetition of the above work.

From the printed authorities, from what I believe is the general rule, viz., to reject one-third of the solution, and from my own experiments detailed above, it seems to me safe to say that anyone who prepares his sugar solutions by putting char *into* them will get results not merely lower than his neighbours, but absolutely too low.—I am, &c.,

J. M. MERRICK.

Laboratory, 59, Broad Street,
Boston, U.S.A., June 25, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 23, June 10, 1878.

Cubes or Prisms of M. Rohart for the Destruction of the Phylloxera.—E. Chevreul.—It is possible to find the proportion of sulphuret of carbon contained in M. Rohart's preparation by introducing a given weight of the substance well dried and finely divided into a small retort, which is heated in the water-bath. The product is collected in a tubulated receiver, to which is adapted a long straight tube drawn out at the extremity.

Thermic Researches on the Chromates.—F. Morges.—The heat of combination of anhydrous chromic acid with water has been in the first place determined:—

$$CrO_3 + H_2O \text{ at } 19{\cdot}5^\circ = CrO_4H_2 = +580 \text{ cal.}$$

This result is far below that for sulphuric anhydride, for which the mean of the numbers found by M. Berthelot and M. Thomsen is 20850 cals. This difference is explained if we remember that anhydrous chromic acid crystallises from its aqueous solution. The regular curve which represents the thermic phenomena of the hydration of chromic acid presents at $4H_2O$ a maximum ordinate which seems to indicate the existence of a hydrate of chromic acid.

Artificial Production of Natron or Natural Carbonate of Soda by the Action of Carbonate of Magnesia upon Chloride of Sodium.—The natural production of natron was ascribed by Berthollet to the action of carbonate of lime on common salt. But this reaction has never been demonstrated experimentally. It is known that calcium chloride, nitrate, and sulphate are decomposable by the bi- and sesqui-carbonates of soda as well as by the neutral carbonate. But even at ordinary temperatures the chloride of sodium is decomposed by the bicarbonate of magnesia, with the production of bicarbonate or sesqui-carbonate of soda. The author's results explain the simultaneous occurrence of natron, and of the large quantity of magnesic chloride found in solution in salt lakes.

Influence of the Physical Condition of Gallium upon its Electro-chemical Part.—J. Regnauld.—The author has some years ago shown that according as a metal in alloying itself with mercury absorbs or liberates heat, it rises or falls in the scale of positive affinities. Zinc, *e.g.*, which in becoming amalgamated absorbs heat, is nearer to potassium than pure zinc, whilst cadmium, which, in uniting with mercury liberates heat, is further from potassium. The analysis of the thermic conditions accompanying the double phenomenon of fusion and of combination between these simple similar bodies, led the author to admit that the disposable chemical work which they possess is a function, not merely of the specific nature of their atoms, but also of the sum of the calories, which maintain them in a given physical state. To prove this view experimentally he endeavoured to form a hydro-electric couple, in which a liquid metal should be negative with relation to the same metal in the solid state. He has succeeded in constructing such a galvanic element with liquid and solid gallium connected by a stratum of a neutral aqueous solution of gallium sulphate. The liquid metal plays the part of zinc, and the solid that of copper.

On Starch.—MM. Musculus and Gruber.—The following distinct compounds have been obtained from starch under the influence of diastase or of dilute boiling sulphuric acid:—Soluble starch, erythrodextrin, achroodextrin α, achroodextrin β, achroodextrin γ, maltose, and glucose.

Action of Caustic Potassa upon Quercite.—L. Prunier.—Aqueous potassa has very little action upon quercite, even at 100°, but about 200° to 250° a profound decomposition sets in. Among the products of decomposition are quinon, quinhydron, pyrogallic, oxalic, and malonic acids.

Action of Fluoride of Boron upon Certain Classes of Organic Compounds.—F. Landolph.—The author proposes as a general law that boric fluoride combines in definite proportions, equivalent for equivalent with the aldehyds, the acetons, and the carbonyls.

Researches on the Peptons.—A. Henniger.—The author concludes that the peptons result from the fixation of water upon the albuminoids.

No. 24, June 17, 1878.

Production of Organic Sulphuretted Compounds Possessing Insecticide Properties.—MM. de la Loyère and Muntz.—A question of priority.

Researches on the Sub-nitrate of Bismuth.—Alf. Riche.—The author has examined a number of commercial samples of this salt, and with a single exception has found a maximum of 1-10th per cent of lead.

Physiological Part of the Hypophosphites.—MM. Paquelin and Joly.—The authors infer from their researches that the hypo-phosphites, like the pyro-phosphates, are mere diuretics, and leave the system as they entered it without having undergone any transformation.

Colouring Matter of Wines.—Arm. Gautier.—The catechins (and their analogues, the quercetins), the tannins, and the vegatable colouring-matters are closely connected together. It is possible to pass from the first to the last, as M. Gautier has ascertained by the limited oxidation of the catechins of gambir. The author endeavours to demonstrate these views as regards the colouring matters of wine, which are not identical as has been supposed. Each kind of grape produces one or more special colouring-matters, the totality of which forms a family of bodies, analogous but not identical, belonging to the aromatic series, playing the part of acids, partly in combination in the form of ferrous salts and appearing to result from the oxidation of the corresponding tannins.

No. 25, June 24, 1878.

Depolarisation of Electrodes by Solutions.—M. Lippmann.—The depolarising power of certain salts has long been known. The first constant current battery constructed in 1829 by M. Becquerel depends on the use of copper sulphate, whilst zinc and cadmium sulphates have been utilised by MM. Du Bois-Reymond and J. Regnault for the construction of impolarisable electrodes and of constant elements. This property, however, has not been studied. The author's experiments reveal an essential condition of the phenomenon. In order that an electrode may be depolarised it must be formed of the metal which is contained in the solution. Thus, copper is the only metal which is depolarised in copper sulphate, whilst gold, silver, and platinum are polarised in this solution. On the other hand, copper is polarised in zinc and cobalt sulphates, &c. A salt depolarises only its own metal. This

principle may be applied to the detection of a metal in a solution. Taking for example copper, if a wire of this metal be plunged in a solution under examination, and taken as the negative electrode of a feeble current, it will not be polarised if the liquid contains 1-5000 of copper sulphate. The presence of copper may thus be detected in a mixture of metallic salts. With a silver wire silver may be detected in like manner.

New Dielectric Constant.—M. Neyreneuf.—On continuing the comparison of different isolating substances employed as the dielectric plates of a condenser, the author has established that for glasses of the same nature that the ratio $\frac{e}{n}$ of the thickness to the number of sparks corresponding to a given quantity of electricity was constant. He has almost determined the value of this ratio for the varieties of glass met with in commerce. For substances much more isolating—such as ebonite, caoutchouc, and paraffin—the above ratio, which may be called the condensing constant, goes on increasing in a marked manner with the thickness. Consequently, only results obtained with plates differing respectively little in thickness are comparable.

An Experiment in Magnetism connected with the Telephone.—J. Luvini.—The author infers from his experiments that the changes produced by magnetising action in a magnetic mass are entirely molecular, and that M. Th. du Moncel, in ascribing the sounds produced in the telephone to the molecular vibrations of which M. de Rive speaks in his "Memoirs" of 1846, is completely in the right.

The Telephone.—M. des Portes.—The author describes a number of experiments made with the telephone, tending to show—as M. Th. du Moncel remarks—that vibrations determined in a magnet by the effect of a shock have for their result the determination of undulatory displacements of the magnetic particles.

Electro-magnets.—E. Bisson.—The author has changed the manner, rolling the wire upon the coils of electro-magnets: at the end of each range he connects the wire in a straight line to the point of departure, in order to recommence the rolling from the same side as in the preceding ranges, and finds an advantage of one-third.

Organised Dust held in Suspension in the Atmosphere.—P. Miquel.—The author finds in his experiments that the number of organic cellules collected varies from 500 to 120,000 per cubic metre of air passed through his apparatus, not including bacteroid particles. Hence it is certain that the atmosphere contains at least a hundred times as many germs as was announced by Drs. Maddox and Cunningham. The author thinks that with more perfect apparatus the number he has obtained might be much exceeeded. He finds that the number of microbia in the air is small in winter, augments rapidly in spring, remains almost stationary in winter, and decreases in autumn. Rain always occasions the recrudescence of these microbia.

Berichte der Deutschen Chemischen Geselschaft zu Berlin. No. 7, 1878.

On Naumann's Method of Determining Molecular Weights.—Hermann Kopp.—Not suitable for useful abstraction.

On Nitroso-compounds of the Fatty Series: No. II.—V. Meyer and J. Züblin.—Three distinct bodies can be obtained at pleasure from methyl-acetic ether and nitrous acid, namely, nitroso-methyl-aceton, nitroso-propionic ether, nitroso-propionic acid.

Formation of Naphthalin and Methyl-violet.—H. Brunner and R. Brandenburg.—In their investigations on the formation of aniline colours by means of bromine, the first results of which were communicated last year (*Berichte*, x., p. 1845), the authors found that the yield of colour was essentially affected by the duration of the process. If equal molecules of dimethyl-aniline and bromine had been heated not above 120° for some hours a beautiful blue-violet colouring matter is produced, the analysis of which shows 4 mols. of hydrobromic acid to 1 of tetra-methyl-rosanilin. On further examination it appeared that one of the atoms of bromine is introduced into the base by substitution, whilst the three others form a tri-hydro-bromate with the bromised tetra-methyl-rosaniline. This colouring matter the authors consider as a mono-brom-tetra-methyl-rosanilin-trihydrobromate. This compound is only formed on cautious working; if the operation is conducted too rapidly, and if the temperature rises above 120°, more reddish shades, poorer in bromine, are formed; the yield of colour is greater, and the proportion of by-products is smaller. Among these products naphthalin was recognised.

Urethan-benzoic Acid.—C. Wachendorff.—If urethan-benzoic acid is heated a few degrees above its melting-point, alcohol and carbonic acid are separated, and the residue congeals again, amidst brisk escape of gases to a brittle mass, from which two substances have been isolated, urea-benzoic acid and urethan-benzoic ethyl-ether.

Fittica's Oxy-para-toluylic Acid.—E. v. Gerichten and W. Rössler.—Fittica's experiments were repeated in the expectation that nitro-toluylic acid would yield oxy-toluylic acid, as in fact took place.

Occurrence of Tricarballylic Acid in the Juice of Beet-root.—E. O. von Lippmann.—The author obtained this acid from a small quantity of a sediment formed in the evaporation apparatus of a sugar manufactory.

On Aurin.—R. S. Dale and C. Schorlemmer.—On the prolonged exposure of aurin to heat along with ammonia a base is obtained which has all the properties of rosanilin. As the formula proposed by the authors, $C_{20}H_{14}O_3$ (?) cannot be harmonised with Hofmann's formula for rosanilin, $C_{20}H_{19}N_3$, they endeavoured to prepare a larger quantity of pure aurin in order to convert it into the base in question. The analysis of aurin prepared from pure phenol as well as of that obtained by the purification of the commercial substance give numbers which agree with the formula $C_{19}H_{14}O_3$. In the meantime they received a communication from E. and O. Fischer showing that the rosanilin prepared from paratoluydin has the formula $C_{19}H_{17}N_3$. They consider the rosanilin obtained from Messrs. Dale and Schorlemmer as identical with their own.

Asparagic Acid and Tyrosin from the Sprouts of Pumpkins.—E. Schulze and J. Barbieri.—The nature of this paper appears sufficiently from the title.

The Flame-reaction of Boracic Acid as a Lecture Experiment.—H. Gilm.—An equably-coloured splendid green flame is obtained by passing the vapours of boracic ether through a narrow tube into a wider vertical tube of glass, and burning it at the upper aperture, mixed with air.

On Hydroquinon-phthalein.—A. G. Ekstrand.—The author, heating 1 mol. anhydrous phthalic acid with 2 mols. hydroquinon, and from two to three times the weight of stannic chloride, to 120° to 130° for twelve to fourteen hours, obtained a yield of 70 per cent hydroquinon-phthalein. It is coloured a deep violet by alkaline solutions, but on boiling or even on long standing it turns a dirty brown. In sulphuric and hydrochloric acid it dissolves with a red colour. Diacetyl-phthalein is obtained by heating phthalein for two or three hours with anhydrous acetic acid.

Action of a Copper-zinc Element upon Alkaline Oxy-salts.—J. H. Gladstone and A. Tribe.—The electrolysis of potassium nitrate and chlorate is here investigated. The general results are that the positive constituent unites with the zinc, whilst the negative is set free among the copper crystals, where it enters into new combinations forming caustic potash and water. The hydrogen does not pass through the solution and is

probably not oxidised at once, but is first condensed by the finely divided negative metal. The zinc compound formed and the alkali decompose each other mutually with formation of the original salt and of zinc hydrate, a molecule of hydrogen being thus available in every cycle.

Decomposition of the Tarry Oil of Lignite at a Red Heat.—C. Liebermann and O. Burg.—Lignite tar on distillation yields a mixture of hydrocarbons closely resembling those of coal-tar, containing 4 per cent of benzol and toluol, and 0·9 per cent of crude anthracen. Much gas is formed, especially from the portions boiling at the highest temperatures. Commercial petroleum suffered a very heavy loss by the formation of gas; it yields considerable quantities of benzol, but scarcely any anthracen. Technically speaking the authors' experiments point to the possibility of utilising the "gas-oil" of paraffin works—now produced in quantity and almost worthless—for the preparation of benzol, toluol, and anthracen.

Action of Trichlorolactic Acid upon Urea.—C. O. Cech.—A preliminary notice.

Formation of Tertiary Amine Bases During the Synthesis of Organic Acids.—Ernst Schmidt.—During the synthetic preparation of a considerable quantity of isobutyl-formic acid, the author, on evaporating the alcohol employed with hydrochloric acid, obtained a large quantity of a salt, which proved to be almost pure tri-isobutylamin.

On Tri-isobutylamin.—Rudolph Sachsleben.—An examination of the salt mentioned in the previous paper.

Chlorine-Derivatives of Naphthalin.—E. Fischer.—On treating naphthalin with chlorine gas in the cold, or with potassium chlorate and hydrochloric acid, there is formed a mixture of addition- and substitution-products. The author has undertaken to isolate and to examine all those substances formed at common temperatures by either of these methods of treatment.

Behaviour of the Products Obtained by Treating Brucin with Nitric Acid and Reducing Agents.—R. Röhre.—If 1 part of brucin is treated with 25 parts of nitric acid of sp. gr. 1·4, and if the red solution is allowed to stand till it has become yellow, and is then mixed with stannous chloride in excess, the well-known deep violet colouration is produced, which soon passes into a dark red. On prolonged standing the liquid slowly becomes colourless, and well-formed violet crystals are deposited on the sides of the vessel. These crystals are soluble in water and mineral acids with a fine violet colour, with the exception of nitric acid, in which they form a yellow solution. In potassa they dissolve with a greenish yellow colour, which, on the addition of an acid, becomes violet. In alcohol they are sparingly soluble, and insoluble in ether, benzol, chloroform, petroleum ether, carbon disulphide, and amylic alcohol. The crystals contain no tin.

Compounds of Organic Bases with Mercuric Chloride.—Otto Klein.—The author is investigating the compounds formed by mercuric chloride with the bases of the aromatic series, and especially how far the basic character of a compound can be weakened without its losing the power of combining with mercuric chloride. Two toluydins (ortho and para), diphenylamin, dimethylanilin, and naphthylamin yield crystalline compounds, whilst acetanilid in the cold shows no reaction.

Researches on the Ketons of the Aromatic Series (Second communication).—W. Stædel.—The compounds here described are the derivatives of benzophenon and diphenylmethan, as also dioxy-diphenyl-keton.

On Mono-chlor-acetylen.—O. Wallach and O. Bischof.—An examination of β-bichlor-acrylic acid, which, when its baric or calcic salt is heated with an aqueous solution of baryta in an apparatus with an ascending condenser, gave rise to a somewhat violent explosion, due to the development of mono-chlor-acetylen.

Regularities in the Boiling-Points of the Chlorinised Ethans.—W. Stædel.—A useful abstraction of this paper would require the insertion of the author's illustrative tables.

Certain Derivatives of Tetra-chlor-ether.—E. Paterno.—A claim of priority as against J. Busch (*Berichte*, v., p. 445).

Acid Imid-chlorides and Amidins.—O. Wallach and A. Gossmann.—The authors point out a formation of secondary amines which may be of importance for the preparation of some of them, and which even points the way for obtaining aromatic tertiary amines, hitherto so difficult of production.

On Aromatic Nitrosamins (Third communication).—Otto N. Witt.—An account of mono-dinitro-diphenyl-nitrosamin.

On Ortho-azo-benzoic Acid.—A. Claus and F. Mallmann.—Pure ortho-nitro-benzoic acid dissolves in potassa with an intense yellow colour, and if sodium amalgam is added to such solutions the colour becomes darker. If the addition of amalgam is continued so that a brisk evolution of hydrogen takes place, and if the mixture is well cooled the pale yellow colour returns. On the addition of acids reactions ensue, which vary greatly according to the circumstances. Thus if the warm solution immediately after the action of the amalgam is mixed with concentrated hydrochloric acid brown or green solutions are obtained, which on boiling turn red- or blue-violet, and on cooling and standing deposit precipitates of a similar colour.

On Azo-phthalic Acid.—A. Claus and O. May.—A preliminary notice.

Azo-benzol-sulphonic Acids.—A. Claus and O. May.—An examination of α-azo-benzol-sulphonic acid, prepared from α(meta)nitrobenzol-sulphonic acid.

Conversion of the Nitriles into Imids.—A. Pinner and F. Klein.—Researches into the action of sulphuric acid upon the nitriles.

Oxy-toluyl-aldehyds and the Accessory Oxy-toluylic Acids Obtainable by the Chloroform Reaction from the threee Isomeric Cresols.—F. Tiemann and C. Schotten.—This paper does not admit of useful abstraction.

Certain Derivatives of Para-homo-salicyl-aldehyd.—C. Schotten.—A notice of para-homo-saligenin, $C_8H_{10}O_2$, of methyl-para-homo-salicyl-aldehyd, acet-para-homo-salicyl-aldehyd, acetic acid-acet-para-homo-salicyl-aldehyd, the homologues of cumarin and cumaric acid, ortho-nitro-para-homo-salicyl-aldehyd, and ortho-nitro-ortho-homo-para-oxy-benzaldehyd.

Reduction of the Aldehyd-oxy-benzoic Acids to Alcoholic Acids.—C. L. Reimer.—The author has converted the three aldehyd-oxy-benzoic acids into the corresponding alcohol acids by means of sodium amalgam.

Action of Chloroform upon α and β Oxy-isophthalic Acid in Alkaline Solution.—C. L. Reimer.—Not suitable for abstraction.

Ethyl-ethers of Pyrogallic Acid and the Cedriret of the Ethyl Series.—A. W. Hofmann.—The author having already recognised cedriret as a derivative of the dimethyl-ether of pyrogallic acid has investigated the homologous cedrirets. He has digested pyrogallic acid, caustic potassa, and potassium ethyl-sulphate, with a large excess of absolute alcohol for twenty-five to thirty hours in soda-water bottles, at a temperature of 100°, and has obtained various novel compounds, especially ethyl-cedriret, $C_{20}H_{24}O_6$.

Decomposition of the Oil of Lignite-tar at a Red Heat.—M. Salzmann and H. Wichelhaus.—The authors announce that they too are engaged with this subject, and that they obtained the best yield of nitrobenzol from the fraction boiling between 200° and 300° of an oil obtained from Hübner, of Zeitz.

Reimann's Färber Zeitung,
No. 23, 1878.

This issue contains a notice of the tinctorial chemicals displayed at the Paris Exhibition. M. Poirrier exhibits violet de Paris, eosin, lutecienne, &c., in splendid specimens. M. J. Casthelaz, in addition to the ordinary coal-tar dyes, shows aureosin and rubeosinic acid. Bédlés, of Clichy, exhibits hexanitro-diphenylamin, diphenylamin, acetanilid, acetoluid, and toluydin in large white nacreous crystals.

L. Thomas, of Javel, exhibits a plate of gallium, of about 6 inches square. Tessié du Motay displays tussah-silk bleached with hydrogen peroxide obtained from baric peroxide.

In order to distinguish artificial alizarin from extract of madder, Goppelsroeder sublimes the specimen and examines it with the microscope. All artificial alizarins contain, in addition to the long orange acicular crystals of alizarin, light yellow crystalline scales of anthraquinon. Or the specimen of dye is extracted with a concentrated solution of alum, the hot filtrate is allowed to cool and filtered again after the bulk of the alizarin has been deposited. Extract of madder shows the well-known fluorescence of purpurin which is wanting in artificial alizarin.

No. 24, 1878.

The account of the tinctorial department of the Paris Exhibition is continued in this issue. Among the most noteworthy objects is a collection of dichroic silk yarns, dyed with fluorescein and displaying the beautiful fluorescence of this colour.

In order to determine the value of tin crystals, Goppelsroeder and Drechsel mix the hot solution with a known quantity of potassium chromate in solution. The stannous salt is thus converted into stannic, and it is merely necessary to determine how much chromic acid remains unreduced in the liquid in order to calculate how much stannous chloride was originally present. Chlorine is, therefore, liberated by the addition of hydrochloric acid, and conducted into a solution of potassium iodide, and the iodine liberated is finally titrated with sodium hyposulphite. To this process Dr. Reimann objects that commercial tin crystals invariably contain a certain proportion of stannic salt, which, if treated as above described must escape valuation.

Rivista Scientifico-Popolare di Statistica, Economia, Agricoltura, Industria, e Varieta.
Anno v., No. 2.

The Diaphonometer of Savalle.—This is an instrument for judging of the purity of commercial samples of alcohol by means of their degree of transparency and colouration after being mixed with a certain reagent, which, however, is not named or described.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 8, June 20, 1878.

The ventilation of the Rotunda of the Palace of the Trocadero is completely successful. The supply of air is after the rate of 40 cubic metres per hour for each person.

At Tarbes, in the Hautes Pyrénées, bundles of straw attached to broom-handles are placed upon the roofs of the houses by way of lightning-rods, and are said to have proved completely successful.

Records of earthquakes have been regularly kept in Japan since the year 400 B.C. Severe shocks have generally been preceded by a rise of temperature and great atmospheric perturbations. On an average there have been ten severe earthquakes each century.

It is announced that at the forthcoming national fête, to be celebrated at Paris, two hundred electric lights will burn during the whole of the night at different points of the city, in addition to those which now regularly illuminate the Place de l'Opéra, the Place de la Concorde, the triumphal arch de l'Etoile, and the front of the Legislative Palace.

At a meeting of the Société d'Encouragement, the Count du Moncel, on behalf of M. Regnier, exhibited improved points for the electric light. They are covered with a slender layer of nickel, which preserves them and concentrates the electric action towards the point.

Experimental Researches on Colour Blindness.—J. Delbœuf and W. Spring.—It is to be regretted that the authors speak of this affection as "Daltonism," and of those suffering from it as "Daltonians."

It is proposed to erect a monument at Rome in memory of the late astronomer Secchi.

Chemiker Zeitung.
No. 24, June 13, 1878.

According to G. C. Wittstein, ground cryolite is occasionally sold under the deceptive name of "enamel soda."

According to the *Archiv. der Pharmacie*, genuine wine-vinegars, if mixed with an equal volume of a solution of potassium dichromate and boiled for about half a minute, turn a dark red—a change which occurs with no other vinegar. Wine-vinegars also give a plentiful precipitate with plumbic acetate.

Bulletin de la Societe Chimique de Paris,
No. 11, June 5, 1878.

Action of Chlorine upon Hydrobromic Ether.—H. Lescoeur.—Hydrochloric acid is liberated, and certain chloro-bromated compounds are formed, several of which the author has examined.

Researches on the Action of Dry Oxalic Acid upon the Primary, Secondary, and Tertiary Alcohols.—A. Cahours and E. Demarcay.—Already noticed.

On Certain Compounds of Lanthanum and Didymium.—P. T. Clève.—A critque on the paper of MM. Frerichs and Smith.—*Liebig's Annalen*, clxii., p. 334.

On Certain Derivatives of Dichlorated Naphthalin η.—P. T. Clève.—The author examines the nitro-dichloro-η compound, the dichloro-η-naphtaylamin compound, and trichloro-naphthalin.

On Aniline-Black which does not turn Green.—S. Grawitz.—The author's processes for dyeing these blacks consist in causing oxidising salts or metallic acids to act upon an acid solution of aniline in presence of the tissues to be dyed. These become green, growing deeper and deeper, and finally black when the oxidation has reached a sufficient term, the bath remaining perfectly clear. He considers that in the formation of these blacks the metal plays a part totally different from what it fulfils in Lightfoot's process. In this latter the metal merely decomposes the chloric acid, which does not produce black, into lower stages of oxidation, which have that effect. In the Grawitz black, in spite of the acidity of the liquid, the metallic oxides obtained from the salts or acids employed are fixed upon the fibre in a true combination with the black, more intimate than in lakes, and very probably in a state of true substitution. One or more molecules of hydrogen are replaced by one or more molecules of the metal, which gives a special stability to the products of the ulterior oxidation by reason of the stability of the metallic oxides and of their affinity for oxygen. The author considers that his theory is fully proved by the following experiment, in which two stages can be traced, in the former of which the metallic acid has an oxidising act on, but in the latter a metallising effect:—Let a black be fixed with chromic acid acidulated with sulphuric acid. As soon as the tissue printed with a black capable of turning green has been worked for some minutes in a boiling bath containing a certain quantity of this mixture, the chromic acid is rapidly reduced, and the yellow liquor

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JUNE, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Clear	0·000	0·009	0·135	0·101	20·80	8·730	0·432	0·94	1·430	14·3	2·80
West Middlesex	Clear	0·000	0·008	0·114	0·073	19·10	8·010	0·828	0·94	1·430	13·2	2·80
Southwark and Vauxhall	Clear	0·001	0·010	0·114	0·098	19·30	8·780	0·432	0·94	1·480	14·3	2·80
Chelsea	Clear	0·001	0·009	0·099	0·090	19·80	8·120	0·396	0·94	1·500	14·3	2·80
Lambeth	Clear	0·001	0·011	0·144	0·098	20·70	8·670	0·432	1·01	1·700	14·8	3·30
Other Companies.												
Kent	Clear	0·000	0·002	0·444	0·003	28·50	11·250	0·648	1·59	3·430	20·6	5·10
New River	Clear	0·000	0·006	0·144	0·045	19·90	8·840	0·468	1·01	0 800	14·8	3·30
East London	Clear	0·000	0·006	0·114	0·056	20·40	8·620	0·820	1·15	1·730	14·3	3·10

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B

turns green. The reagents have therefore exhausted their oxidising power, but the black still turns green on exposure to sulphurous acid. The amount of the reagents may be indefinitely increased, and the black may be rendered grey, or even destroyed, without affecting its property of turning green. But if, on the other hand, the tissue is worked in the bath with the original dose of chromic and sulphuric acids for half an hour or longer, the green liquor becomes a violet-red, the black is fixed and is no longer capable of becoming green, and all the chromic oxide derived from the reduction of the chromic acid has disappeared from the liquid, and is found deposited upon the black portions of the cloth. [Has it been analytically proved that no chromic oxide remains in the liquid? To what is the violet-red colour due?]

On Brown Alizarin.—M. Prud'homme.—This new product, if fixed with potassium ferricyanide or chromic acetate, gives light shades varying from a mode to a grey. The heavy shades seem difficult to obtain. With alkaline reducing agents brown alizarin gives a red liquor, which, on exposure to the air, becomes covered with a blue scum. The dye seems identical with that which may be obtained by an alkaline reduction of nitro-alizarin. If a solution of nitro-alizarin in caustic soda is heated for a long time in presence of a stannous salt, or of the hydrosulphite of soda, the colour becomes successively violet, blue, red, and is covered with a blue scum. The new colour may be useful along with the red and blue alizarins, in substitution for dyes which require to be fixed with albumen. —*Bul. de la Soc. Ind. de Mulhouse.*

MISCELLANEOUS.

South London School of Pharmacy.—On Saturday, July 13, the presentation of the Medals and Certificates to the successful candidates at the last school examinations for the session held between July 4 and 8, took place at this institution, when the Secretary announced the awards as follows:—Senior Chemistry: Medal, Mr. Phillips; Certificate, Mr. Stonham. Junior Chemistry: Medal, Mr. Lumby; Certificate, Mr. Humfrey. Botany: Medal, Mr. Humfrey; Certificate, Mr. Lovely. Materia Medica: Medal, Mr. Powell; Certificate, Mr. Humfrey. Pharmacy: Medal, Mr. Lovely; Certificate, Mr. Lumby.

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JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 31st May, 1878.

MANCHESTER CORPORATION GAS-WORKS.—AMMONIACAL LIQUOR.—The TIME for RECEIVING TENDERS has been EXTENDED from the 1st of August to the 1st of October next.—By order of the Gas Committee,

JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 5th July, 1878.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 974.

ON THE

PRODUCTION OF MAGNESIUM NITRIDE BY SMOTHERED COMBUSTION OF MAGNESIUM IN AIR.

By J. W. MALLET.

THE existence of a nitride of magnesium was first noticed by Deville and Caron,* in connection with the purification of the metal by distillation.

Briegleb and Geuther† afterwards obtained this compound by passing ammonia or nitrogen over strongly heated magnesium. The amorphous mass produced, of greenish-yellow colour, had approximately the composition Mg_3N_2. I have lately observed the formation of the same substance in large quantity in the simple combustion of magnesium with limited access of air.

Using the burning of a piece of magnesium ribbon, as it so often has been used, to illustrate to students the fact that the metal gains in weight by oxidation, I held the coiled-up ribbon pretty well down in a porcelain crucible to diminish the loss of magnesia in fume carried up by the heated air, and finally dropped a part of the metal, still burning, into the bottom of the crucible.

Washing the vessel out afterwards, I noticed that water at once produced effervescence and a distinct smell of ammonia.

On repeating the experiment with a larger piece of the ribbon, placed at once at the bottom of the crucible, the same result was obtained, and with far greater distinctness when magnesium filings were used, the residue in this latter case having a well marked greenish yellow colour, and giving off abundance of ammonia on addition of water or a solution of a caustic alkali. When but a few drops of liquid are added, the heat evolved is so great as sometimes to ignite a portion of the mass, and much of the powder is scattered by the escaping ammonia and vapour of water.

The porcelain being attacked, and a dark brown film of silicon formed upon it, I wished to ascertain whether this element had anything to do with the absorption of the atmospheric nitrogen, and therefore substituted an iron crucible, but without changing the result. The magnesium used was itself examined, and found free from silicon.

The chief part of the metal burned is, of course, converted into oxide, with the production of a temperature high enough to induce the remainder, when the supply of oxygen is limited, to unite with nitrogen. The amount of nitride formed varies with the manner in which the combustion is managed. I have found the best result to be obtained when the crucible, of usual Berlin porcelain shape, is filled to about one-third its depth with the filings, and heated gently over a lamp, the filings ignited at the top by a red-hot iron wire, and from time to time, but not continuously, gently stirred with the wire. A peculiar orange glow, unlike the brilliant light of the magnesium burning with free supply of air, and a slight apparent clotting together ot the filings, indicate the formation of the nitride.

To determine approximately how far nitrogen may thus be taken up, I in several instances weighed the metal, and, cooling the crucible rapidly by standing it upon an iron block, transferred its contents to a small flask, in which was a test-tube of water or a solution of potassium hydrate. Attaching a set of absorption-bulbs with a measured volume of normal sulphuric acid, I very gradually tilted the flask so as to bring the alkaline liquid in contact with the powder, and, after action in the cold was over, heated to the boiling-point, and drew air through the apparatus with an aspirator. The unsaturated acid in the bulbs was determined with a normal alkaline solution.

The three experiments showing the largest absorption of nitrogen gave the following results. A little magnesium was lost in the fumes, but that, doubtless, altogether in the form of oxide:—

	Mg used. Grms.	NH_3 obtained. Grms.	Equiv. Mg_3N_2. Grms.	Equiv. Mg. Grms.	Mg converted into nitride per 100 pts. used.
No. 1.	2·635	0·292	0·859	0·618	23·5
No. 2.	2·204	0·286	0·841	0·606	27·5
No. 3.	3·117	0·365	1·074	0·773	24·8

This mode of treating magnesium furnishes a simple and effective lecture-table illustration of the formation of a metallic nitride, and of some of the reactions presented by bodies of this class.

University of Virginia, April, 1877.

PHOSPHORUS IN IRON ORE AND IN IRON.*

PART II.

By J. E. STEAD, Middlesbrough.

(Concluded from p. 31.)

I ENDEAVOURED in the first part of this paper to lay before you, in a very condensed form, investigations made with the aim of removing phosphorus from iron ores and from the crude products of our blast-furnaces.

It is intended this evening to describe some of the changes which take place when air is blown through phosphoretted metal; also to consider the value of manganese oxides, chlorine, bromine, iodine, and hydrogen, as agents for removing phosphorus, leaving the question of ore purifications as a yet unsolved problem, and one which to our mind will not be readily solved to the satisfaction of the practical iron manufacturer.

I have first, then, to turn your attention to the action of air. When metal containing manganese, silicon, carbon, and phosphorus is acted upon when in a fluid state by a stream of air, we have every reason to believe that all the elements present—probably with the exception of carbon—are oxidised in the ratio in which they exist in the metal and that a very basic cinder is at first produced, which, by calculation, would have the following composition, in the case of Cleveland iron being used, viz.:—

Cleveland Pig-Iron.	Per cent.	Cinder produced by Action of Oxygen.	Per cent.
Iron	92·65	Protoxide of iron ..	93·4
Carbon	3·25	,, manganese	0·5
Manganese	0·50	Silica	3·4
Silicon	2·00	Phosphoric acid ..	2·7
Sulphur	0·10		
Phosphorus	1·50		
	100·00		100·0

It has been found, however, that it is impossible to obtain by direct experiment cinder of this composition, for, almost instantly after its formation, as we might reasonably expect, the manganese, silicon, and phosphorus, still present in the fluid mass, are oxidised by the oxygen of the protoxide of iron, from which the iron is reduced, which, leaving the cinder, returns to the bath and is replaced by the oxides of manganese, silicon, and phos-

* *Comptes Rendus*, xliv., 394.
† *Ann. d. Chem. u. Pharm.*, cxxiii., 228

* Read before the Cleveland Institution of Engineers, December 10, 1877.

phorus. In consequence of the rapidity with which these reactions take place, the cinder, which we have been able to draw off from the metal, is always more or less saturated with silica, phosphoric acid, and oxide of manganese. The following analysis of cinder was made on that which was produced by blowing on the surface of molten Cleveland iron. It was collected by placing the end of a cold bar about half an inch in front of the air jet, on the surface of the metal. The molten oxides were blown forward, and solidified on coming in contact with the cold iron, to which they adhered. The bar with cinder was afterwards removed, and the cinder examined, the results of which are below, viz. :—

	Per cent.
Protoxide of iron	64·91
Peroxide of iron	12·68
Protoxide of manganese, &c.	2·30
Silica	14·71
Phosphoric acid	5·40
	100·00

In a Bessemer converter, when the temperature is low enough, there can be no doubt that a portion of the phosphorus is at first removed; that the iron, manganese, silicon, and phosphorus are burnt just in the proportion in which they are present; and that the rich iron oxide at first produced will remove a second portion of phosphorus, on being mixed up with the still impure metal. Such, however, is the violent agitation to which the metal is subjected that the cinder and iron are continually in intimate contact, and, as a consequence, the cinder is very rapidly saturated with silica and phosphoric acid. The power of silicon to reduce oxide of iron is very great; in fact, by simply heating to a high temperature, in a crucible, silicious pig metal and a limited amount of mill cinder or oxide of iron, about 80 per cent of the oxide will be reduced to the metallic state, and a super-saturated silicious slag will remain on the surface of the metal.

In the Bessemer converter, then, after the saturation point has been reached, when the silica and phosphoric acid have both in combination with them the proper chemical proportion of oxide of iron, the still unoxidised silicon in the metal will continue to reduce the oxide in the cinder, and will replace it with silica. It is clear, when this has been attained, viz., the removal of a base and the substitution of an acid, in a compound already saturated with acid (silica), that silica must be in excess, and that, as this acid is much more powerful than phosphoric acid, it will take away the oxide of iron at first in combination with it, by which reaction free silica or silicic acid and iron phosphates become free phosphoric acid and iron silicate.

The silica from the bottom and sides of the converting vessel is during "the process" rapidly worn away, and this passing into the cinder will also take part in the reactions.

Having now arrived at the point at which the phosphoric acid is expelled from its combination with iron oxide, and remains in the free state dissolved in the cinder, we must endeavour to explain what action manganese and silicon, as they exist in fluid iron, have upon free phosphoric acid.

Manganese has, like silicon at low temperatures, a very powerful attraction for oxygen, and it was thought to be not at all improbable that this element would have a greater attraction for oxygen than phosphorus, and that oxide of phosphorus or phosphoric acid and manganese, when brought together, would be followed by the manganese attracting from the phosphorus the oxygen in combination with it, by which action oxide of manganese and free phosphorus would be produced.

In order to ascertain if this change actually takes place, puddlers' tap-cinder super-saturated with silica, which was added to it in order that the phosphoric acid might be liberated or expelled from its union with the oxides in the cinder, was poured, when in a fluid state, upon melted spiegeleisen, containing a large amount of manganese.

After the mixture was thoroughly shaken up, so as to expose the spiegel in every part to the phosphoric cinder, the metal was run off and allowed to set. An analysis of the spiegel, before and after treatment, gave the following result, viz. :—

	Before.	After.
Carbon	4·65 per cent.	4·63 per cent.
Manganese ..	21·50 ,,	18·05 ,,
Silicon	0·85 ,,	0·93 ,,
Phosphorus ..	0·06 ,,	0·72 ,,

Phosphoric acid reduced = 1·51 = 0·66 per cent
P = manganese oxidised = 3·45 per cent.

Judging from these results, it is clear that the theory, that manganese is capable of reducing free phosphoric acid at a temperature comparatively low, is correct.

When pig-iron after fusion is brought into contact with fluid oxide of iron, the silicon and phosphorus are removed simultaneously, from which fact certain investigators have concluded that their attraction for oxygen, at comparatively low temperatures, is about equal. This is, however, not the case, for when silicious fluid metal is poured upon phosphoric acid, a portion of that substance is decomposed, free phosphorus and silica being produced. The following are the results obtained from an experiment conducted as described :—

	Metal.	
	Before treatment.	After treatment.
Phosphorus ..	1·11 per cent.	1·50 per cent.
Silicon	5·95 ,,	5·37 ,,

Phosphorus reduced from phosphoric acid = 0·39 per cent.
Silicon oxidised by phosphoric acid = 0·58 per ct.

In a second experiment the phosphoric acid in fluid puddlers' tap-cinder was liberated by the addition of silica, and to this pig-iron containing silicon was added. After shaking the vessel containing the mixture for a short period, the metal was poured off, allowed to set, and carefully analysed. The results obtained were as foliows, viz. :—

	Metal.	
	Before treatment.	After treatment.
Silicon	1·25 per cent.	0·75 per cent.
Phosphorus ..	1·00 ,,	1·33 ,,

We may, therefore, conclude that the attraction of silicon for oxygen is greater than the attraction of phosphorus for that element, and that, when free phosphoric acid is exposed to the action of silicon, as it exists in fluid metal at low temperature, oxygen is drawn or attracted from the phosphorus, which is thus liberated, the silicon combining with the oxygen to form silica or silicon dioxide.

We must now turn our attention to the action of fluid carburetted iron at low temperature on free phosphoric acid.

The results of an experiment in which fluid iron containing little or no silicon and manganese was poured upon solid phosphoric acid, placed at the bottom of a red-hot crucible, clearly showed that the acid had suffered decomposition. The metal before and after treatment had the composition as given below, viz. :—

	Before.	After.
Carbon	3·40 per cent.	3·20 per cent.
Silicon	0·08 ,,	0·08 ,,
Phosphorus ..	0·04 ,,	0·30 ,,

We see, then, from these experiments, what would occur in the Bessemer converter, when the phosphoric acid in the cinder—continually produced during the first

part of the process, when the temperature is not extreme —is expelled from its combination with oxide of iron, by the absorption of silica. For as manganese, silicon, and carbon, as they exist in fluid iron, readily reduce free phosphoric acid, we should naturally expect the whole of it at first removed would be returned to the bath, and that the cinder would contain little or no phosphoric acid. The following is an analysis of such a cinder, taken from a converter, in which Cleveland iron was being blown, confirming the absence of any quantity of phosphoric acid:—

Silica	65 per cent.
Iron	15 ,,
Phosphoric acid	trace.

As there has been reference, time after time, in the foregoing remarks, to the point at which oxide of iron becomes saturated with silica, and as the question is of a very important nature, several experiments were made with the aim of solving it.

In order to do this, cinder, containing little more than a trace of phosphoric acid, was mixed with variable proportions of sand, and these, after fusion, were agitated with fluid iron containing phosphorus. The metal in each case was tested after the treatment for phosphorus, and if no diminution was detected it was concluded that in the cinder employed there was absent any free oxide of iron. The results were as follows, viz.:—

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.	No. 4. Per cent.
Protoxide of iron ..	73·90	64·50	55·50	47·68
Peroxide of iron ..	11·60	10·60	8·50	6·87
Silica	10·50	20·40	31·00	40·00
Alumina, lime, &c. ..	4·00	4·50	5·00	5·45
	100·00	100·00	100·00	100·00
Metallic iron	65·60	57·60	49·12	41·89
Ratio of iron to silica	1 to 0·16	0·35	0·63	0·95
Phosphorus in metal—				
Before treatment ..	1·51	1·51	1·48	1·48
After treatment ..	0·13	0·04	0·25	0·75
	No. 5.	No. 6.	No. 7.	No. 8
Protoxide of iron ..	42·13	43·41	38·57	29·57
Peroxide of iron ..	10·71	8·13	7·86	5·00
Silica	44·00	46·00	51·00	62·50
Alumina, &c.	3·16	2·46	2·57	2·93
	100·00	100·00	100·00	100·00
Metallic iron	40·27	38·34	35·50	26·50
Ratio of iron to silica	1 to 1·06	1·20	1·44	2·36
Phosphorus in metal—				
Before treatment ..	0·91	0·91	0·91	0·91
After treatment ..	0·89	0·90	0·91	0·91

We see, then, that when the ratio of iron and silica in the cinder is as 1 to 1·06, the compound is incapable of oxidising phosphorus from fluid iron containing it.

This ratio is almost exactly the same as that of the chemical equivalents of iron and silica, viz., as 56 to 60. We may therefore conclude that one equivalent of silica saturates or neutralises one equivalent of iron in the state of oxide, or, expressed in more intelligible language, that one part of iron is saturated with 1·07 parts silica. In No. 1 experiment the results are apt to mislead without a little explanation. It will be seen that there has not been so much phosphorus removed as in No. 2, in which the cinder was not so pure as in the first case. This, however, was due to the very sluggish nature of the cinder, which prevented the intimate admixture with the metal when the contents of the vessel containing them was agitated—a state of things which did not exist in the second experiment.

I have now to turn your attention to a fact of great theoretical interest, and that is, that it is, within certain limits of temperature, impossible to drive off from cinder its phosphoric acid by the addition of silica.

We know very well that silica is a much stronger acid than the phosphoric, and that it will liberate the latter from its combination with bases; and we were prepared to find that, when an excess of silica was added to puddling cinder, and the mixture fused at a moderately high temperature, the liberated acid would be volatilised, for free phosphoric acid, heated by itself, passes off as vapour at a temperature a little above redness.

The result obtained, when experimenting in the manner described, proved that no phosphoric is volatilised even when the temperature is raised to the melting-point of steel. The results obtained were as follows, viz.:—

Analyses of Cinder after Fusion.

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent
Protoxide of iron	41·91	37·55	32·14
Peroxide of iron	6·30	4·50	3·86
Silica	42·20	49·00	56·00
Phosphoric acid	5·18	4·50	3·73
Lime, &c.	4·41	4·45	4·27
	100·00	100·00	100·00
Metallic iron	37·00	32·35	27·70
Ratio of iron to silica	1 to 1·14	1 to 1·51	1 to 2·03
Ratio of iron to phosphoric acid—			
Before fusion	1 to 0·140	1 to 0·140	1 to 0·140
After fusion	1 to 0·140	1 to 0·139	1 to 0·139

We are taught from these results what great tenacity the cinder has for phosphoric acid, and they also are confirmatory of the theory that the whole of the phosphorus, removed in the various processes in which oxide of iron is used for purifying iron, is retained by the cinder, and that none is vapourised and carried up the stack with the waste products of combustion from the furnace grate.

I have now to turn to the value of manganese oxides as agents for purifying iron from phosphorus.

As ores containing manganese are frequently employed for fettling puddling furnaces, I considered the question to be of sufficient importance to demand investigation, and I have therefore turned my attention to the matter, and now hope to be able to satisfactorily explain them.

There are several compounds of manganese and oxygen, the principal of which are the protoxide and the peroxide, the latter of which contains twice as much oxygen as the former.

When the peroxide is heated by itself to a temperature above dull redness, one-third of its oxygen is drawn off, and if mixed with substances capable of readily absorbing oxygen, and heated to a sufficiently high degree, half of it is separated, and protoxide of manganese remains. The protoxide, however, retains its oxygen with much greater tenacity, and it is only at very elevated temperatures decomposed in presence of *reducing agents*. Judging from these facts alone we naturally concluded that protoxides of manganese would be without any direct action on the phosphorus existing in fluid iron, and the result of experiment fully confirmed the theoretical deduction. As, however, this oxide has a much greater attraction for silica than iron oxide, it is highly probable that it plays a part of secondary importance in the cinders of the purifying processes, by taking up the silica, which would otherwise be saturated by oxide of iron, and would thus leave the latter free to act upon the metal.

In this respect, however, as the equivalents of manganese and iron are about equal, manganese cannot be held to be of more value than iron.

Peroxide of manganese, when forced under the surface of molten iron, parts with half its oxygen, which, acting upon the oxidisable impurities in the metal, removes

them. The following results prove this to be the case, viz.:—

	Before treatment.	After treatment.
Carbon	3·30 per cent.	3·10 per cent.
Silicon	1·51 ,,	0·20 ,,
Manganese ..	0·54 ,,	0·11 ,,
Phosphorus ..	0·90 ,,	0·50 ,,

When oxide of iron acts upon phosphorus, for each part of that element oxidised 4·5 parts of pure iron are reduced from the oxide. When manganese peroxide acts upon phosphorus the oxidation is effected by free oxygen. and therefore there is no gain in weight by the separation of metal.

The oxygen available in 7 lbs. of manganese peroxide will oxidise 1 lb. of phosphorus; whereas that, in 5·8 lbs. of protoxide of iron, there is the same amount of oxygen, but as the 2·3 lbs. of phosphoric acid produced would require about three times its weight of oxide to carry it off, the total amount would be $5·8+(2·3\times8)=12·7$ lbs. This would yield 4½ lbs. of pure iron, which, at say three times the value of the original oxide, would more than cover its cost.

We see, therefore, that peroxide of manganese is of much less value than iron oxides.

The next subject for our consideration is the value of fluor-spar as an agent for removing phosphorus.

This substance, as all interested in the subject know, has been very prominently brought before the public as possessing, when in combination with oxides of iron, the power of removing phosphorus in the puddling process from crude iron. Unfortunately, however, I have not had an opportunity of investigating its action as thoroughly as could be wished. When, however, phosphide of iron is fused with fluor-spar, Dr. Percy states no action whatever takes place, and I have found on experiment a similar result.

In order to find what action a mixture of fluid oxide of iron and fluor-spar has upon Cleveland iron, two-thirds of mill-tap and one-third spar were fused and thoroughly mixed up with molten iron. The iron before and after treatment was tested, with the following results, viz.:—

	Before treatment.	After treatment.
Carbon	3·30 per cent.	3·10 per cent.
Silicon	1·50 ,,	trace
Phosphorus ..	1·48 ,,	0·16 ,,

Now, although the greater part of the phosphorus was removed in this case, it will be seen by former experiments that better results have been obtained from the use of mixtures of oxide of iron and sand.

The results, however, from its use in a puddling furnace may be very different, and I hope shortly to be able more thoroughly to investigate its action.

I now turn to chlorine, bromine, and iodine for consideration as purifiers of metal.

All these elements form definite compounds with phosphorus: but they are all decomposed when brought into contact with red-hot iron, the phosphorus leaving the compounds to combine with the iron. Experiments in which these elements were mixed with molten Cleveland iron gave negative results.

Judging from this fact we should consider that there would be no advantage derived from their use.

We next treat of hydrogen, considered as an agent for removing phosphorus.

Hydrogen, like chlorine, can be obtained in combination with phosphorus, in which state it exists as a colourless gas, but also, like chlorine, it has less attraction for it than iron. Iron wire will burn in phosphoretted hydrogen gas, the combustion being kept up by the rapid combination of the phosphorus and iron.

If, therefore, iron will draw phosphorus from hydrogen, it is clearly impossible for hydrogen under similar conditions to attract it from iron. We therefore consider hydrogen, in all its combinations, to be incapable of removing phosphorus from iron. Water has been advocated as an agent for removing phosphorus, it being held that the hydrogen would combine with it, and pass off as phosphoretted hydrogen gas. This question was solved practically by pouring molten Cleveland iron into water, and carefully analysing the gases evolved, and also the metal before and after the treatment. The following were the results obtained, viz.:—

Pig metal.	Before.	After.
Phosphorus ..	1·48 per cent.	1·48 per cent.

Analysis of Gases evolved from Molten Cleveland Iron in Water.

Hydrogen	79·69 per cent.
Carbonic oxide	12·48 ,,
Marsh gas	4·87 ,,
Sulphuretted hydrogen ..	1·74 ,,
Carbonic acid	1·22 ,,
Phosphoretted hydrogen ..	none
	100·00

A considerable amount of sulphur was removed, the greater part of which was absorbed in the water. The metal lost half its sulphur by the operation.

And now, in concluding this paper, I would remark that, so far as our present knowledge goes, there is nothing to surpass in point of cost and efficiency the process of purifying by means of oxide of iron.

The process of adding fluid Cleveland iron to fluid oxides, first patented and made public by Mr. John Gjers, of this town, is now receiving thorough investigation by Mr. I. L. Bell, and I strongly believe it will become of great commercial value to this district eventually. The principal point of interest and importance in Mr. Bell's investigation is the discovery of the fact that, by acting upon fluid iron at low temperature with molten cinder, the carbon is not oxidised to any material extent, and that, in consequence, after the phosphorus is removed, the metal will remain sufficiently fluid to admit of being poured out liquid from the furnace, and removed in that state to a Siemens furnace or Bessemer converter for conversion into steel.

When the purification is conducted at higher temperatures, although the phosphorus may be as perfectly removed, there is also oxidised a considerable amount of carbon, and the purified metal will solidify at much lower temperature than that containing a larger proportion of that element.

Attention was drawn in the first part of this paper to a laboratory experiment in which fluid metal and cinder were violently shaken together in a crucible for about a quarter of a minute, by which treatment the metal was almost perfectly freed from phosphorus. From this it was maintained that if a mass of impure metal could, by practical means, be sufficiently subdivided, and exposed in that state to fluid oxide, the phosphorus would be removed in an incredibly short space of time. Whether or not there exists any machine capable of producing such an intimate mixture, and, if not, whether such a machine can be produced, are questions which should demand the most serious consideration of our Cleveland engineers. The question is now essentially a mechanical one, and the future prosperity of Cleveland depends on its practical and satisfactory solution.

I myself am very sanguine that the time is not far distant when Cleveland ironstone will yield steel which will rank as high as that made from the pure ores of Spain and Cumberland.

Application of the Microphone in Surgery.—The microphone has been successfully employed in the detection of urinary calculi, and it may probably serve also to indicate the position of the fragments of projectiles.—*Les Mondes.*

NOTES FROM THE PARIS EXHIBITION.

THE METALLURGY OF PLATINUM.

We have been favoured by some notes on the magnificent exhibits of Johnson, Matthey, and Co., of platinum and rare metallic preparations, at the Paris Universal Exhibition, 1878.

From these notes we learn that from the year 1800 to 1809 a relative of a present member of this eminent firm was employed in working upon platinum, and discovered the process for its treatment and consolidation, which, generally known as the process of Wollaston, has been until late years in use here, and up to the present time on the Continent. The first apparatus of platinum ever made for the concentration of sulphuric acid was completed in December, 1809, and was supplied to some works now existing near London. The weight of platinum used in this apparatus was 423 ounces.

The work of this firm in connection with this valuable metal may be summed up under the following heads:—

The Metallurgy of Platinum.—The separation and production in a state of purity of the metals, rare and precious, of which the native ore chiefly consists, viz.:—Platinum, ruthenium, iridium, rhodium, osmium, palladium, large quantities of which are now in the Exhibition in a state of great purity.

The Fusion of Platinum by the process first commercially brought to notice by MM. H. St. Claire Deville and Debray in about the year 1856. By the fusion of pure sponge platinum (instead of its simple compression, uniting it by forging under the old system, which must always produce metal more or less porous) it is obtained in a condition of the most perfect compactness, strength, and durability, and of increased resistance to the action of acid. Messrs. Johnson, Matthey, and Co. melt ingots of pure platinum of any weight up to 10,000 ounces.

The Patent Autogenous Soldering (*i.e.*, the joining together of platinum by means of the oxy-hydrogen blowpipe).—Experiments with a view to carry out this process were begun in the year 1859, perfected in 1860, and have since been adopted by the firm for all important work. The boilers, &c., shown in the London Exhibition of 1861 were all manufactured upon this system. It is manifestly more advantageous that the whole should be equally durable and uniformly of the same metal, without the inequalities and disadvantages which do and must always exist with gold soldering. The absolute perfection and superiority of this process over the old method have been proved by the results of working more than 160 concentrating boilers, of capacities varying from 20 to 180 gallons. By the old system of working up a still from one piece of metal (which is, however, only practicable with small sizes), that portion of the apparatus which requires most strength, the bottom and lower portion of the sides, is necessarily the thinnest, whereas the dome and upper portion of the sides, where least strength is necessary, becomes the thickest, thus causing an absolutely useless and detrimental waste of metal. When under the old system gold-soldered joints are used for the larger-sized vessels, this evil is only partially mitigated, whilst the use of gold involves extra and useless cost to the purchaser, who has to pay not only for the gold employed at three times the price of platinum, but also for the double thickness of that metal where unnecessary, without in the smallest degree adding to the durability or effective working of the apparatus. The new system is therefore based upon true metallurgical principles, the whole of the apparatus being rendered more perfect and solid than by the old process, with the great advantage of the thickness of metal being regulated in accordance with the relative wear and tear of its various parts.

Apparatus for the Concentration of Sulphuric Acid.—The first sulphuric acid still made in 1809 was of a deep circular form, and was worked under a leaden chamber. Since that time boilers and pans of different sizes, some entirely of platinum, and some with leaden hoods, were in use up to the year 1855, the principle being to have a deep layer of acid, digested for a considerable time. In 1855 Messrs. Johnson, Matthey, and Co. showed in the Paris Exhibiton a still constructed upon the principle of running through in a continuous stream a shallow layer of acid of about two inches in depth, the drawing for which had been prepared by the eminent chemical engineer, Mr. W. Petrie. In 1862 they again exhibited an improved apparatus on the same general principles, but with an arrangement by which the acid was drawn from a compartment in the centre of the vessel, by a tube connected through its side with the cooler.

A writer in a German contemporary remarks that this process of working with corrugated rectangular boilers has had astonishingly favourable results. The flat layer of acid sliding on the corrugated surface is forced, by the effect of the partitions placed in the vase a little above the bottom, and produces thus a continual concentration at 66° full, which in the other known systems does not take place in the great generality. By the employment of this new system there is said to be an economy of 50 per cent in the first saving of platinum, of 70 per cent in the cost of attendance and general labour, and 48 per cent in the consumption of fuel.

Alloys of Platinum.—The preparation of the alloys of platinum of this firm, especially of the alloy with 10 per cent of iridium, demand special attention. They show a metre rule in course of construction by the system of "planing" instead of the method of drawing through plates, being the most effectual for obtaining mathematical exactness of shape and perfect purity. They also show a finished kilo. standard weight, of the density 21·52.

The following also deserve attention from visitors to the Exhibition:—Platinum and Gold Pyrometer to determine the degree of heat in the boiler.—Laboratory Alembic for making hydrofluoric acid, &c.—Platinum Assay Apparatus.—Square and Round Platinum Serpentines of extraordinary workmanship, shown as specimens of the perfection of autogenous soldering.—Platinum Tube, 500 centimetres long, in one piece, diameter 0·05 m.m.—Palladium Tube and Ingot.—Pure Palladium Mass, weight 65½ kilos., value 260,000 frs. (£10,400), extracted from about 125,000,000 frs. worth of native platinum and gold.—Pure Palladium Disc, in which nearly a thousand times its volume of hydrogen gas has been occluded. This volume of gas would be represented by a column nearly 2000 m.m. high, and 100 m.m. diameter. Original diameter of flat disc of metal, 100 m.m.; diameter after the charging of gas, 102·5 m.m.; the concavity having been caused simply by the absorption of gas; original thickness, 2 m.m.; thickness afterwards, 2·2 m.m.; original weight, 187·3775 grms.; weight afterwards, 188·2882 grms.—Platiniferous metals, viz., pure ruthenium, 2 kilos. (compressed ingot), value 40,000 frs.; pure rhodium, 2 kilos. (melted ingot); pure osmium, 2 kilos.; pure iridium, 2 kilos. (melted); pure palladium, 2 kilos. (forged ingot).—Fine Wires of the metals, gold platinum, palladium, silver, copper, iron, aluminium, each of 0·001 in. = 0·025 m.m. diam., 1 kilometre of each, weighing as under—

Gold	18·66 grms.
Platinum	20·0 ,,
Silver	10·16 ,,
Copper	8·50 ,,
Palladium	15·50 ,,
Aluminium	3·0 ,,
Iron	7·0 ,,

The Rare Metallic Preparations exhibited include osmic acid, hypo-ruthenic acid, platinocyanide of magnesium, sodio chloride of rhodium, &c.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Annual General Meeting, April 30, 1878.

E. W. Binney, F.R.S., F.G.S., President, in the Chair.

The following gentlemen were elected Officers of the Society and Members of the Council for the ensuing year:—

President—James Prescott Joule, D.C.L., LL.D., F.R.S., F.C.S.

Vice-Presidents—E. W. Binney, F.R.S., F.G.S.; E. Schunck, Ph.D., F.R.S., F.C.S.: R. A. Smith, Ph.D., F.R.S., F.C.S.; H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Secretaries—J. Baxendell, F.R.A.S.; O. Reynolds, M.A., F.R.S.

Treasurer—C. Bailey, F.L.S.

Librarian—F. Nicholson, F.Z.S.

Other Members of the Council—Rev. W. Gaskell, M.A.; R. D. Darbishire, B.A., F.G.S.; W. B. Dawkins, M.A., F.R.S., F.G.S.; B. Stewart, LL.D., F.R.S.; C. Schorlemmer, F.R.S.; W. E. Axon, M.R.S.L., F.S.S.

"*The Distribution of Ammonia*," by Dr. R. Angus Smith, F.R.S., &c.

If organic matter is everywhere, ammonia is everywhere possible, and if that matter is decomposing, ammonia is everywhere. This is the general statement which this paper illustrates. It is now many years since it was observed by me that organic matter could be found on surfaces exposed to exhalations from human beings; but it is not till now that the full significance of the fact has shone on me, and the practical results that may be drawn from it in hygiene and meteorology. These results are the great extension of the idea that ammonia may be an index of decayed matter; the idea itself has been used partly and to a large extent, as illustrated in my "Air and Rain." The facts now to be given enable us to claim for it a still more important place. The application seems to fit well the conditions already examined, and by this means currents from foul places have been readily found. This does not apply to the substances which may be called germs, whether it be possible to see them or not, because these are not bodies which have passed into the ammoniacal stage, although some of them may be passing; those, for example, which are purely chemical and exert what we may call *idiolytic* action. This word may serve to mark this peculiar action, which was left by Liebig unnamed; he used the vague term invented by Berzelius, namely, catalytic. I have elsewhere recognised the two classes of germs, instead of any disputed one, without naming them.

It is now many years since Liebig first surprised me by saying that iron ores and aluminous earths were capable of taking up ammonia, and if they were breathed upon we were able even to smell that substance. He, much about the same time, made numerous experiments in order to find the ammonia of the atmosphere, and to measure its amount in rain. The result for science was great, and Professor Way continued the enquiry for the Royal Agricultural Society. Dr. Gilbert, F.R.S., amongst his many labours in the department of agricultural science, has made this enquiry into ammonia of rain in still later times, but I shall not at present quote his results, as this paper does not intend to go fully into the subject, but rather to indicate its magnitude and importance. The first paper I ever read to this Society was on the ammonia found in peat: I was unable then to see the extent of the subject.

I shall give parts of the fuller paper without the long tables of results.

Ammonia must ever be one of the most interesting of chemical compounds. It comes from all living organisms, and is equally necessary to build them up. To do this it must be wherever plants or animals grow or decay. As it is volatile, some of it is launched into the air on its escape from combination, and in the air it is always found. As it is soluble in water it is found wherever we find water on the surface of the earth or in the air, and probably in all natural waters, even the deepest and most purified. As a part of the atmosphere it touches all substances and can be found on many; it is in reality universally on the surface of the earth, in the presence of men and animals, perhaps attached more or less to all objects, but especially to all found within human habitations, and we might also add, with equal certainty, the habitations of all animals.

If you pick up a stone in a city, and wash off the matter on the surface, you will find the water to contain ammonia. If you wash a chair or a table or anything in a room, you will find ammonia in the washing; and if you wash your hands you will find the same: and your paper, your pen, your table-cloth, and clothes, all show ammonia, and even the glass cover to an ornament has retained some on its surface. You will find it not to be a permanent part of the glass, because you require only to wash with pure water once or twice, and you will obtain a washing which contains no ammonia. It is only superficial.

This ammonia on the surface is partly the result of the decomposition of organic matter continually taking place and adhering to everything in dwellings. The presence of organic matter is easily accounted for, but it is less easily detected than ammonia. It is probable that the chief cause of the presence of ammonia on surfaces in houses and near habitations is the direct decomposition of organic matter on the spot. If so, its presence, being more readily observed than organic matter itself, may be taken as a test, and the amount will be a measure of impurity. A room that has a smell indicating recent residence will, in a certain time, have its objects covered with organic matter, and this will be indicated by ammonia on the surface of objects. After some preliminary trials, seeing this remarkable constancy of comparative results and the beautiful gradations of amount, it occurred to me that the same substance must be found on all objects around us, whether in a town or not: I therefore went a mile from the outskirts of Manchester, and examined the objects on the way. Stones that not twenty hours before had been washed by rain showed ammonia. It is true that the rain of Manchester contains it also, but considering that only a thin layer would be evaporated from these stones it was remarkable that they indicated the existence of any. The surface of wood was examined —palings, railings, branches of trees, grass (not very green at the time), all showed ammonia in no very small quantities. It seemed as if the whole visible surface around had ammonia. I went into the house and examined the surfaces in rooms empty and inhabited, tables, chairs, ornaments, plates, glasses, and drawing-room ornaments. A (Parian) porcelain statuette, under a glass, showed some ammonia; a candlestick of the same material (but uncovered) showed much more; the back of a chair showed ammonia, when rubbed with a common duster, very little. It seemed clear that ammonia stuck to everything.

If, then, ammonia were everywhere, the conclusion seemed to be that it was not at all necessary to do as I had been doing, namely, wash the air so laboriously; it would be quite sufficient to suspend a piece of glass, and allow the ammonia to settle upon it. For this purpose small flasks were hung in various parts of the laboratory, and they were examined daily. The flasks would hold about 6 ounces of liquid, but they were empty, and the outer surface was washed with pure water by means of a spray bottle; it was done rapidly, and not above 20 c.c. (two-thirds of an ounce) of water was used. This was tested for ammonia at once with the Nessler solution. The second washing produced no appearance of ammonia, done immediately. Ammonia could be observed after an

hour and a half's exposure at any rate, but I do not know the shortest period. The results of the washings were as follows; they are the average of 34 experiments for some, and 17 for others; in all 238 experiments:—

	Height from floor. Ft. In.	Ammonia. M.gms.	Height from floor. Ft. In.	Ammonia. M gms.
Front laboratory	7 3	0·013	4 2	0·019
Second landing	6 0	0·032		
Balance room ..	5 1	0·015	0 8	0·009
First landing ..	4 10	0·007		
Back laboratory	4 5	0·010	0 6	0·010
Entrance lobby	6 5	0·007		
Office	4 7	0·003		
Back yard ..	4 8	0·036	0 7	0·042
Back closet ..	2 3	0·105		
Midden	—	0·572		

The first three belonging to the working laboratory are not very regular, as we might suppose, but they never rise very high, nor do they sink to the lowest. The rest, except the second, keep a remarkable similarity, and the differences are very great. In the second there is a disturbance caused by sweeping the floors. On the other days it was requested that everything should be kept still. This of course brings in a practical difficulty, and limits the use of the test to cases where care can be used and thoughtful observation, since there are many ways by which dust may be made to interfere, even although the act of sweeping should not take place. The house experiments gave similar gradations.

The result seems to be that a piece of glass, of a definite size, hung up in any place, will receive deposits of ammonia, or substances containing ammonia, in a short time; and by washing the ammonia off with pure water, and testing it with a Nessler solution, it may be seen whether there is too much or not. It is the simplest test for ammonia yet found. Its discoverer deserves great thanks. It must not be forgotten that we may have ammonia in very different conditions; it may be pure, or it may be connected with organic matter. This mode of enquiry is better suited as a negative test to show that ammonia is absent, than to show what is present. When ammonia is present there may be decomposing matter; when absent there is not. I am hoping to make this a ready popular test for air—a test for sewer-gases,* for over-crowding, for cleanliness of habitations, and even of furniture, as well as for smoke and all the sources of ammonia. Of course it must be used with consideration and the conclusions must not be drawn by an ignorant person.

How far it may be used as a test of climate is a matter to be considered also.

After this I made another series of trials with air, Nesslerising the washings at once, and not after laborious distillings, as in former cases: the results are very valuable, showing that we obtain comparative quantities equally in this way.

The amount of ammonia obtained in this ready way does not give exactly the same results as the more laborious methods which I have used, but it may be taken as the most convenient. It must be observed that the amount rises exactly where you might expect more organic matter to exist. The lowest is from Prince's Road, outside the town, and almost a half a mile from the extreme of the Manchester houses. The next is obtained from an empty yard behind my laboratory, but it is still pure because there was wind and rain; and anyone who observes how unusually pleasant it is to breathe air even of a smoky town during wind and rain will not be surprised. I have not yet, however, had the purest air. I shall require to make a campaign on the moors, hills, and seas before I can give numbers for this. I have not even obtained the best given on land at a distance from manufactures. All this will be done in time.†

In my office the amount is larger than outside, but the air is not so bad as it is in front, and not so good as sometimes in the front where it is open. From the back of the laboratory during fog the ammonia was much higher, but during one day it was excessive, and a special examination of it was made in several streets. The highest amount was obtained at the front of the Cathedral, about midday, on the 8th of February, 1878, when the amount was 1·25, or 14½ times more than it had been found in Prince's Road, showing a considerable range:—

	M.grms. of Ammonia per cubic metre of air.
Prince's Road	0·086
Open yard during rain	0·119 and 0·102
Front of laboratory	0·167 ordinary
Office	0·167
Front and back during fog ..	0·476
Close shut up room	0·413
Closet outside	0·800 to 0·900
Densest part of fog	1·25

CORRESPONDENCE.

TELEPHONIC REPEATER.

To the Editor of the Chemical News.

SIR,—Allow me to state that the telephonic repeater described by Messrs. Houston and Thomson in your issue of June 21st was invented by me over a year ago, and one of the many forms devised by me was published in the *Journal of the Telegraph*, July 15, 1877, and also in the *Telegraphic Journal*, of London, about the same date.—I am, &c.,

T. A. EDISON.

Menlo Park, N.J., July 8, 1878.

BLOWPIPE CANDLES.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxviii., p. 14) is an article by an American writer on blowpipe candles, in which no mention whatever is made of the blowpipe candles described by me at pp. 45, 48, "Pyrology." May I ask Mr. Casamajor, through your columns, if he has ever seen or heard of that book?—I am, &c.,

W. A. ROSS.

London, July, 18, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 1, July 1, 1878.

On Sulphuric Saponification.—E. Fremy.—The author describes his former researches on the decomposition of neutral fatty bodies by treatment with sulphuric acid, and adverts to the extensive industrial application of his discoveries.

System of Telephone without Electro-magnetic Organs based upon the Principle of the Microphone.—Th. du Moncel.—Hitherto the microphone has only been regarded as a telephonic transmitter, there being carcely any suspicion that it might constitute a receiver

* For sewage also to a larger extent than it has yet been used.

† Since the paper was read I examined trees and stones at Skelmorlie and Wemyss Bay, finding very little ammonia.

destined to reproduce to the ear the sounds transmitted by an apparatus of the same kind. A microphone suitably arranged speaks distinctly, though less strongly than the telephone, and the ordinary microphone itself can reproduce to the ear the sounds resulting from mechanical vibrations produced upon the board supporting the apparatus. Thus scratchings upon the board, the trepidations and sounds occasioned by a musical-box placed upon the microphone are distinctly heard. The mercurial telephone of A. Breguet requires no electro-magnetic apparatus, and emits sounds by the vibrations resulting from the oscillations of the mercurial column. But in the apparatus in question the effects produced are much more extraordinary as the vibration destined to produce them can only result from variations in the intensity of a current closed by the intervention of imperfect contacts, and to hear the sounds it is sufficient to place the ear against the stand upon which the charcoals are mounted.

Thermic Researches on the Chromates.—M. Morges.—It results from the author's experiments that the electrolytic decomposition of the chromates is not comparable to that of the alkaline sulphates. The quantity of heat which remains confined, according to the researches of M. Favre, ought to be 28,000 calories; but it does not exceed 12,500. The chromates, from a thermic point of view, seem more analogous to the carbonates, for which the confined heat does not exceed 21,000 calories.

Single Liquid Battery becoming Depolarised by the Action of the Atmosphere.—M. Pulvermacher.—In this battery the atmospheric air is employed as a natural depolarising agent, without the use of any artificial chemical oxidising agent, and gives a relative constancy to the element. The exciting liquid (dilute sulphuric acid, caustic potassa, or sal-ammoniac) is placed in a porous cylindrical vessel; the positive metal is formed of a rod of amalgamated zinc immersed in the liquid, and the negative element is formed of fine silver or platinum wire coiled round the cylinder. The spirals of silver wire are too remote from each other for the production of capillary action, and the wire is at an infinity of points in contact with the liquid exuding from the porous vessel. The rapidity of depolarisation is such that, on closing the circuit (resistance of 10 ohms) during ten minutes, the electromotoric force diminishes by about 16 per cent, and returns to its original value in three minutes after opening the circuit.

On Trichloric Acetal.—H. Byasson.—Trichlor-acetal is a transparent mobile liquid, of a peculiar odour, staining paper like the fatty bodies. It boils at 197°; its sp. gr. =1·288. It is sparingly soluble in water, but miscible in all proportions with alcohol, glycerin, common and acetic ether, chloroform, benzol, and the formenic carbides. Hydrochloric acid is present among the products of its combustion.

On Ethoxyacetonitrile.—T. H. Norton and J. Tcherniak.—This compound is a colourless, very mobile liquid, of a peculiar but agreeable odour and burning taste. It is sparingly soluble in water, but miscible with alcohol and ether in all proportions. It boils at 132° to 133° under a pressure of 758·5 m.m. Its sp. gr. at 20° =0·9093. Alcoholic potassa decomposes it at the boiling-point with disengagement of ammonia.

New Method of the Formation of Ethylic Glycolate.—T. H. Morton and J. Tcherniak.—Glycolide is sealed up in tubes with an equivalent quantity of absolute alcohol, and heated for several hours to 200°; the operation is complete when the glycolide has entirely disappeared. The contents of the tubes are diluted with water, and carbonate of potassium is added, enough to separate all the ether which floats upon the surface of the saline solution. It is dried and distilled. The yield is almost theoretic.

Action of the Hydrochlorates of the Amines upon Glycerin.—J. Persoz.—In view of a question of priority which may possibly arise the author refers to a sealed paper deposited at the Academy in February, 1876, containing an account of his first observations.

Anærobiosis of Micro-organisms.—M. Gunning.—The author has previously recommended ferrous ferrocyanide as an extremely sensitive reagent for oxygen, and has by this means shown that the apparatus and media in general use for the culture of micro-organisms cannot be freed from oxygen by the methods usually recommended for this purpose. These observations throw a legitimate doubt upon the experiments serving as the basis of the doctrine of anærobiosis, and he has therefore repeated these experiments with the necessary precautions. He has made use of glass vessels sealed at the lamp, in which the largest possible quantities of putrescible matter were placed in contact with minimal quantities of oxygen. Urine, blood, meat-broth, yeast-water, &c., in a recent state were infected with bacteria taken from similar substances in full putrefaction. The vessels were then sealed and exposed to a temperature of 38° to 40°. Putrefaction was at once set up, but was definitely arrested in every case after a longer or shorter time—often very short—but always sensibly proportionate to the quantity of oxygen supposed to be present. The author attributes the cessation of putrefaction solely to the death of the bacteria caused by the absence of free oxygen. If the vessels containing putrescible matters terminate on one side in tubes fitted with a plug of wadding or coiled round several times, the point being drawn out to a fine point and sealed at the lamp, we may, at any desired moment, by breaking the point, expose anew the putrescible matters to the contact of atmospheric air, deprived, however, of germs. If the substances have been allowed to reach the state of complete inertia air no longer produces the least phenomenon of putrefaction, or of appreciable alteration. Blood, however, forms an exception, as it undergoes an alteration similar to that described by Pasteur in his "Etudes sur la Bière," p. 49, effected without the aid of organisms. This experiment seems to prove not merely that the bacteria as well as their germs are dead, but that the organic matters are not capable of spontaneously producing others. These experiments furnish the most conclusive proofs against spontaneous generation.

Emissive Power and the Different Kinds of Heat which Certain Bodies Emit at the Temperature of 100°.—Prof. Villari.—There is for each body a thickness possessing a maximum emissive power. This thickness varies with the substances, being from 3·45 m.m. for powered rock salt to 0·03 m.m. for Indian ink. The thickness varies also with the aggregation of the matter; thus, for lamp-black deposited directly it is 0·200 m.m., whilst it does not exceed 0·069 m.m. if the lamp-black has been previously stirred up with sulphide of carbon. As the same laws extend to the absorbent power of bodies, thermoscopes, in order to produce their maximum effect, should be covered with a layer of lamp-black 0·2 m.m. in thickness. Different bodies have different thermic and thermo-chroic emissive powers—that is to say, if the heat emitted at 100° by each of them were visible they would all appear differently coloured with different intensities.

Les Mondes, Revue Hebdomadaire des Sciences, No. 9, June 27, 1878.

A quarry of lithographic limestone has been discovered in Algeria, at 8 kilos. distance from the port of Oran. The quality is declared equal to that of the stone from the old quarries of Munich, now exhausted.

The annual meeting of the French Association for the Advancement of Science will take place in Paris.

Experiments on Capillarity.—M. Röntgen.—According to Wilhelmy the density of a liquid is augmented by the contact of a solid body immersed in the liquid. The

author has repeated these experiments, and has weighed successively in a liquid a solid mass and the same mass broken into fragments, when the surface is augmented, and according to theory the weight of the body ought also to increase. The results of experiments made upon gypsum immersed in alcohol or in oil of turpentine and upon glass in alcohol are negative.—*Poggendorff's Annalen.*

Quantitative Spectral Analysis.—M. Vierordt.—In 1871 the author proposed to divide in two the slit of the spectroscope; the plates of one of the portions of the slit being set in motion by micrometric screws, which rendered it possible to equalise the spectrum of a light viewed directly through the narrow portion, and the spectrum of the light after its passage through an absorbent transmitted by the other portion. The intensity of the light, within the limits of experiment, is proportional to the width of the slit. At present he substitutes for this arrangement two others; in one the four plates of the slit are separately movable; in the other two of the plates are regulated by a screw, and move in opposite directions; the two others are separately movable. The errors of measurement are very trifling, and may be corrected by means of tables appended to the memoir.—*Poggendorff's Annalen.*

Differences of the Affinities of Chlorine, Bromine, and Iodine.—M. Kühlmann.—The author measures the quantities of heat evolved in the reaction $M+R+xHO$. M is a metal, R may be chlorine, bromine, or iodine, and x a very high number. He shows that if bromine and iodine are substituted for chlorine in aqueous solutions of hydracids or of haloid salts the differences of affinities as measured by the quantities of heat liberated are multiples of the number 5·350. The ratio of the differences of the affinities of chlorine to bromine or of chlorine to iodine is 2 to 5. This number recurs, though less distinctly, in other reactions. It is the simple proportion of $\frac{1}{3}$ and $\frac{1}{8}$ with the numbers 18·725 and 13·375, which, according to Thomsen are often met with in analogous experiments.—*Poggendorff's Annalen.*

Quantitative Spectral Analysis.—M. Hüfner.—The two halves of the slit of the spectroscope are illuminated by two pencils of rays, one of which traverses the absorbent, whilst the other can be darkened at pleasure. As source of light a petroleum lamp is employed placed in the focus of a lens; half of the pencil of rays falls at the angle of polarisation upon a mirror, which throws it back upon a parallel mirror not tinned, placed before the upper portion of the slit; a Nicol's prism fixed before the eye-piece serves to decrease the polarised pencil without acting upon the other. Before the lower part of the slit is fixed a double prism formed of a prism of transparent glass and one of smoked glass. It is rendered equal with the Nicol's prism, and the absorption corresponding with a given rotation is deduced once for all. This instrument gives chemical indications as precise as can be desired.—*Journal fur Prakt. Chemie.*

Researches upon Fluorescence.—M. Brauner.—Solar rays are caused to fall upon two rectangular prisms of crown glass cemented together by their hypothenuse surfaces; on turning this system all the refrangible rays may be eliminated, *e.g.*, as far as D. This light is concentrated by a lens upon the substance to be examined, and it is viewed through a system of two rectangular prisms of flint glass, cemented together by their hypothenuses, between which essential oil of cassia has been placed. The rotation of this system causes all the red rays to disappear, for instance, as far as D. White paper thus observed appears dark, but eosin and naphthalin red appear green, which confirms the results of Lommel. This arrangement of prisms gives more light than the ordinary spectroscope.—*Wiener Anzeiger.*

No. 10, July 4, 1878.

The Guinard prize of 10,000 francs has been awarded to Prof. Melsens, of Brussels, for his researches on the use of potassium iodide in combatting saturnine and mercurial affections.

Chemiker Zeitung.
No. 23. June 6, 1878.

Chemical Industry at the Paris Exhibition.—Dr. C. Deite.—The author complains of the admission of many small articles, which must certainly rank as chemical products, but which mark no advance in science, especially inks, blacking, and varnishes. In the French department there are about twenty exhibitors of blacking. Dr. Deite rejoices that the German Government refused to take part in the Exhibition, as a contrary conduct on their part would merely have tended *in majorem gloriam* of France. Next to the French department the English is the most important in point of space, and as it—thanks to the political constellations—enjoys relatively the largest space for all objects exhibited it is the easiest to overlook. Nowhere do chemical preparations present themselves to the eye of the beholder with such elegance as in the English department. "The American display is unexpectedly unimportant. This agrees ill with the prophecies so often uttered by the enthusiasts of protective duties that the chemical industry of America would soon prove a serious competitor for us in Europe."

Preparation of Tungstic Acid.—Dr. G. Thenius.—The author takes 50 parts of finely pulverised wolframite, and digests it in a flask upon the sand-bath with 2 parts of pure concentrated hydrochloric acid and one part of pure concentrated nitric acid, shaking it from time to time. It is then diluted with an equal quantity of distilled water and filtered, and the residue once more digested with aqua regia. It is filtered again, the residue washed upon the filter with distilled water, and digested with ammonia until the tungstic acid is completely dissolved. The whole is then thrown upon a filter, upon which a mixture of silicic and niobic acids remains. The filtrate after standing for twenty-four hours deposits a yellowish white precipitate. This is removed by filtration, and the filtrate evaporated to crystallisation. The crystals of ammonium tungstate thus obtained are heated in a flat porcelain capsule till the ammonia is expelled. The yield from 50 parts of the mineral proved to be 21 parts of tungstic acid.

Berichte der Deutschen Chemischen Gesellschaft,
No. 8, 1878.

Investigations on the Absolute Boiling-point.—A. Ladenburg.—The author treats, first, lecture experiments, remarking that, although the researches of Cagniard Latour, Drion, Wolf, Mendelejeff, and Andrews are of great importance for a correct understanding of the relations between the state of vapour and that of liquidity, they seem scarcely to be noticed by chemists. As it has now become very desirable to introduce the main propositions of the kinetic theory of gases into lectures on general chemistry, it will be necessary to treat the relations between pressure and volume in gases and vapours more thoroughly. The law of Mariotte, or rather of Boyle, will not be sufficient; the signification of the isotherms will have to be explained, as also the interesting experiments of Andrews, which necessarily involves a consideration of the phenomena of the critical point or the absolute boiling-point. He then figures and describes an apparatus for the observation of the phenomena in question. The author then passes to a consideration of the methods for the determination of the absolute boiling-point.

Nature of the Silicon Compounds Occurring in Plants.—W. Lange.—The author has undertaken to prove what definite silicon compound occurs in the sap of a plant (*Equisetum hiemale*), and secondly of what

kind are the compounds peculiar to the cellulose, probably of all mature vegetable tissues which appear as an irremovable constituent of the ash. The silicic acid in the juice of the *Equisetum* is chiefly combined with magnesia, but the proportions which vary indicate a mixture of a silicate with free base. As regards the second question the author concludes that the constituents of the ash must be present in the texture of the plant in a state almost insoluble.

Derivatives of the Phenylen-diamins.—E. Wundt.—The author has obtained methenyl-ortho-phenylen-diamin by heating ortho-phenylen-diamin with formic acid, and is now engaged in preparing the ethyl compounds of the derivatives of ortho-phenylen-diamin by heating it with iodethyl.

Aldehyd Derivatives of Amins and Ureas.—Hugo Schiff.—An examination of the compounds formed by glyoxal and aniline; by glyoxal and meta-toluylen-diamin; glyoxal and benzidin; benzidin and acetaldehyd, valeraldehyd, œnanthol, furfurol, benzaldehyd, and silicylaldehyd; benzidin with anhydrous phthalic acid, urea, the mustard oils, and œnanthol.

Remarks on the Previous Treatise.—A. Ladenburg.—A question of priority.

On Methylen-methylamin.—J. Romeny.—A preliminary notice. If trimethylamin is passed through a tube at dull redness in a current of hydrogen, a volatile base condenses in a refrigerated receiver.

Constitution of the Hydrocarbon Formed from Triphenyl-methan-chloride by the Abscission of HCl.—W. Hemilian.—A hypothetical paper.

On a Base, $C_{19}H_{18}N_2$.—H. Böttinger.—Benzalchloride and ammonia in an alcoholic solution at common temperatures act upon each other very gradually. If the mixed solutions are heated to 100° in sealed tubes rapid decomposition sets in, sal-ammoniac and the oil of bitter almonds being formed. A very strong reaction ensues if a small quantity of zinc powder is thrown into the mixture, and the whole shaken up, the temperature being raised 45°. The base $C_{19}H_{18}N_2$, described by the author on p. 276 of the *Berichte* is not a perfectly pure body. It was prepared by heating benzalchloride with aniline in sealed tubes, with or without zinc powder. Along with the base there are formed resinous bodies, which render purification more difficult. Recent experiments have shown that this base forms with benzol a double compound, sparingly soluble in benzol. The base, if heated with mercuric chloride in sealed tubes to 100°, or, with caution, in open tubes, yields a peculiar compound. The immediate product of the reaction is freed from excess of mercuric chloride by means of water, when a dark shining paste is formed. If treated with alcohol it dissolves, partially forming a reddish blue liquid, which dyes silk blue. The dried residue of the solution has a beautiful cupreous lustre, but has hitherto not been perfectly freed from mercury. Check experiments were conducted with the aniline and mercuric chloride employed, when a coloured fluid was obtained, but of far less intensity and tinctorial power. The author has also examined the products obtained by the action of benzalchloride upon dimethylanilin, orthotoluydin, and paratoluydin.

On a Mono-brom-pyromucic Acid.—The authors caused a molecule of brom to act upon pyromucic ether, and obtained an addition product, which, on treatment with alcoholic potassa, gives up hydrobromic acid, whilst the ether group is saponified, and an acid is obtained of the formula $C_4H_2BrO - \cdot\cdot COOH$.

Certain New Double Compounds of Picramid.—K. H. Mertens.—The author having obtained a large quantity of picramid, prepared from dimethylanilin by methods to be made known on some future occasion, confirms the observations of Pisani, Liebermann, &c., on its properties and melting-point. It crystallises in yellow transparent prisms with a fine violet reflection. The melting-point is exactly 188°. If very cautiously heated beyond its melting-point in small quantities, it sublimes in long, pale yellow, plumose laminæ, with a greenish lustre. If re-crystallised from its pure yellow solution in alcohol the crystals melt at 108·5°. From a small quantity of benzol picramid crystallises in long sharply-pointed needles, but if the concentrated solution is left to itself for some time or allowed to evaporate spontaneously there are formed broad, transparent, pale yellow prisms, which, if taken out of the liquid and laid upon blotting-paper, effloresce in a few minutes and crumble down to a yellow powder. Analysis shows that there is here formation of a double compound, analogous to benzol-picric acid. Picramid combines also with toluol, forming brownish transparent needles, analogous in composition to the former compound, and consisting therefore of equal molecules of picramid and toluol. Picramid-anilin forms thick, black, shining, well-developed prisms, or very long needles with a deep purple reflection. If powdered the colour is a blood red. The author has also examined picramid-paratoluydin.

Reduction of Ellagic Acid by Zinc Powder.—L. Barth and G. Goldschmiedt.—Rembold had previously distilled ellagic acid with zinc powder, and obtained a hydrocarbon, which he named ellagen and to which he ascribed the formula $C_{14}H_{10}$. The authors have ascertained that it is identical with Berthelot's "fluoren," and have obtained and examined certain of its derivatives.

Decomposition Products of a Gum Ammonia from Morocco Obtained by the Action of Melting Potassa.—Guido Goldschmiedt.—The gum-resin in question is obtained from an umbelliferous plant (*Ferula tingitana*?) From its decomposition the authors obtained resorcin and a substance taking a splendid red colouration with ferric chloride, and probably identical with the compound obtained by Hlasiwetz and Barth on oxidising benzoin and gamboge with caustic potassa.

Action of Bromine upon Disulphophenolic Acid.—M. v. Schmidt.—The author has obtained the acid $C_6H_5BrS_2O_7$, and has examined its potassium, barium, lead, and silver salts.

On Trisulphoxybenzoic Acid.—M. Kretschy.—It seemed to the author interesting to submit meta-oxybenzoic acid to the action of sulphuric acid and anhydrous phosphoric acid under increased pressure. It was found practicable to introduce the SO_3H group three times into the molecule of oxy-benzoic acid. Several of the salts of the new acid are described.

On Bixin.—C. Etti.—The author obtains bixin as follows:—1·5 kilo. of commercial annatto freed from leaves are digested in the water bath with 2·5 kilos. alcohol at 80 per cent to which 150 grms. soda-ash must be added, the temperature being maintained at 80°. The mass takes a brown colour, and is rapidly filtered while hot; the residue pressed between heated plates and again extracted with 1·5 kilo. of alcohol at 60 p. c. The filtrates from the first and second extraction are mixed together with the addition of half their volume of water, when a part of the sodium-compound separates out on cooling, the more complete precipitation being effected on adding the needful quantity of a concentrated solution of soda. After standing for some days the precipitate, which is crystalline, is collected upon a cloth, and freed by strong pressure from the mother-liquor. It is purified by re-crystallisation, and for this purpose it is dissolved in portions, in an excess of alcohol of 60 per cent, at the temperature of 70° to 80°; quickly filtered, the filtrate again, as above described, diluted with water when cold, and mixed with solution of soda. The deposit after a few days is collected upon a cloth, pressed, stirred up to a paste with dilute alcohol, and mixed with pure and tolerably concentrated hydrochloric acid till a distinctly acid reaction is obtained. The bixin now deposited is perfectly washed with water, pressed, and finally dried at 100°. For the

preparation of the other colouring matters of annatto, the liquids filtered from the deposits of bixin-sodium are employed. They are acidulated with HCl, when a red voluminous precipitate is formed, which is washed with water, pressed, dried at 20° to 30°, ground to a fine powder, and extracted with ether till the liquid runs off only very slightly coloured. On evaporation the ether leaves a reddish black resinous mass, which has not been examined. The portion insoluble in ether is amorphous bixin. The author then gives a description in detail of crystalline and of amorphous bixin.

The Action of Iodine upon Guanidin Carbonate and Nitroso-guanidin.—M. v. Rechenberg.—An account of experiments undertaken with the view of producing simple substituted guanidins, after having recognised the impossibility of obtaining the free guanidin bases in sufficient quantity.

On Atmospheric Hydrogen Peroxide (Fourth Communication).—E. Schöne.—The author gives, as his general conclusion, the following law:—The higher above the earth's surface the condensation of atmospheric aqueous vapour takes place, the richer in hydrogen peroxide is the resulting precipitate.

Constituents of the Mineral Water found by Boring in the Eifel, near Pelm, at the Foot of the Casselburg.—H. Vohl.—The author infers from his analysis that the water of this spring can never serve as a substitute for the Birresborn waters.

Mineral Constituents of the Spring at Marpingen.—H. Vohl.—This water can have no medicinal action.

On the Plato-iodo-nitrites.—L. F. Nilson.—The author on a former occasion showed that the plato-nitrites of potassium and barium, on treatment with iodine and alcohol, are converted—with simultaneous formation of aldehyd and ethyl nitrite—into products which may be regarded as plato-nitrites in which two NO — - — O groups are replaced by a molecule of iodine. The iodised derivatives thus obtained are true intermediate links between the plato-nitrites and the iodo-platinites.

Action of Water upon Phosphenyl-chloride and on Simple Phenylated Solid Hydric Phosphide, $C_6H_5P_4H$.—H. Götter and A. Michaelis.—Not adapted for useful abstraction.

Oxidation of the Sulpho-xylolic Acids (Fourth Communication).—W. Iles and I. Remsen.—The authors declare that they have been in error as regards the connection between the two xylol-sulphamides and the acid obtained,

Constitution of the Metaxylol-sulphonic Acids.—Oscar Jacobsen.—A lengthy paper, incapable of useful abstraction, and containing various controversial passages directed against the conclusions of MM. Iles and Remsen.

Remarks on the Memoir "On Chlorcymol from Thymol and Substances closely connected therewith."—Ira Remsen.—The author points out an essential error in the reasoning of the memoir quoted.

MISCELLANEOUS.

Congrès International d'Hygiène, Paris.—The Council of the Sanitary Institute of Great Britain have appointed a committee, consisting of His Grace the Duke of Northumberland, President; Mr. Edwin Chadwick, C.B.; Dr. Richardson, F.R.S.; and Dr. Long Marsh, to represent the Sanitary Institute at the Congrès International d'Hygiène in Paris from the 1st to the 10th of August next. During the Congress in Paris the Société Française d'Hygiène, with which the Sanitary Institute is affiliated, will entertain at a Banquet on the 9th of August the members of the Sanitary Institute and their other Foreign Associates. Gentlemen desirous of attending the French Congress, whether members of the Institute or not, should apply to the Registrar, at 20, Spring Gardens, S.W., who will furnish them with the necessary Bulletin d'Adhésion, as supplied by the Committee of Organisation in Paris.

NOTES AND QUERIES.

Analyst for Australia.—Can anyone inform me whether there is any probability of a young analyst obtaining a situation in Australia, either with an analytical chemist or in a mineral works, also in what part?—A CONSTANT READER.

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c

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II. The Superficial Gravels and Clays around Finchley, Ealing, and Brentford. By Thomas Belt, F.G.S.
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IV. The Evolution of Beauty. By T. F. Mott, F.R.G.S.
V. Feeling and Energy; Alternate Affections of Matter. By W S. Duncan.

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JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 31st May, 1878.

MANCHESTER CORPORATION GAS-WORKS.—AMMONIACAL LIQUOR.—The TIME for RECEIVING TENDERS has been EXTENDED from the 1st of August to the 1st of October next.—By order of the Gas Committee,

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 975.

CONTRIBUTIONS TO BLOWPIPE CHEMISTRY.

THIRD PAPER.—MISCELLANEOUS NOTES.

By P. CASAMAJOR.

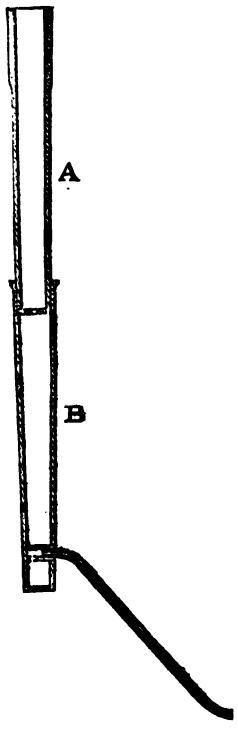
I. *The Shortest Pocket Blowpipe.*

Over two years ago I published in the Chemical News (vol. xxxiii., p. 50), and in the *American Chemist* (Dec., 1875), a description of a blowpipe, which, when packed for the pocket, has a length of 4½ inches, and, when adjusted for use, gives a length of 8 inches from the mouth-piece to the tip of the jet. This relation of 4½ to 8 was a trifle less than that of any pocket blowpipe that had previously been proposed.

In the above description, as published in the Chemical News, occurs the following:—"If the stem of the blowpipe is made in two pieces, while the jet is made with a double curve, the length, when put up for the pocket, can be reduced to 3¾ inches, which gives the still smaller ratio of 3¾ to 8, which, I believe has never before been attained. I have one of these dimensions whose stem is formed of two conical portions with circular sections. When packed for carrying one cone fits into the other, and the curved jet fits within the inner cone."

Fig. 1 (full size).

Fig. 2 (scale ½).



As neither at the time of publishing the above, nor since then, have the figure or a detailed description of this blowpipe been given, I propose to give both now, as I believe that this blowpipe still enjoys the distinction of being, when packed for the pocket, the shortest ever made. In Fig. 1 it may be seen in this condition, and in Fig. 2 it is shown as arranged for use.

In this figure we may see that the stem is formed of two conical tubes, A and B, of about the same length. The small end of A enters into the large end of B. The larger end of A is left open, while its smaller end is closed with a plate having a hole in its centre, to allow the passage of the air into B. The conical tube B is also open at its larger end, but closed by a plate at its smaller end. About half an inch from the smaller end is an opening in the tube B, made to receive a small piece of pipe, which is soldered to edges of the opening, and to a place inside of the tube B, diametrically opposite to the opening. This short piece of pipe, which serves as a socket to receive the jet, is provided with a hole, to allow the air to escape from the tube B into the jet.

A blowpipe of this kind is very easily made by taking two ordinary jeweller's blowpipes, which cost about 15 cents a-piece, and filing off the curved portion. There remain two straight conical tubes, which are placed one within the other. We may then cut from the outside tube a piece about 3 inches long, from which we make the tube A. At the smaller end is soldered a perforated plate. From the inside tube we make the pipe B, by closing its smaller end with a plate, and by putting a ring around its larger end. This ring answers the purpose of stiffening this end and keeping its shape true, and it also serves to take hold of when the tube B is to be drawn out of the tube A (see Fig. 1). The perforated plate at the smaller end of A is also designed to keep this end from deformation. It also serves as a diaphragm with a small perforation to divide A from B, which allows the stem to be divided so as to leave a lower chamber, which some think is an advantage in the case of the blowpipe of Gahn, commonly ascribed to Berzelius or Plattner.

It may be noticed in the figures that the larger end of A is made thicker than the rest of this tube. This extra thickness represents a silver tube soldered over the brass tube in the part that enters in the mouth.

The jet is made from a piece of brass tubing. Before curving it, it should be filled with rosin, to prevent it from collapsing. This jet should be made to fit very accurately in a larger piece of tubing, which is afterwards soldered in the tube B, to serve as a socket for the jet, as shown in Fig. 2. To prevent the jet from dropping out of the inner tube, this is closed with a cap, the edge of which is shown in Fig. 1.

II. *Charcoal Borers.*

In his excellent work "On the Use of the Blowpipe in Chemical Analysis and Mineralogical Determinations," Berzelius gives a charcoal borer, which is remarkable for its extreme simplicity. It consists in a conical tube of tin plate, open at both ends, these ends being sharpened with a file, so as to present two circular edges. By using either the larger or smaller end of the cone we may bore holes of two different sizes in charcoal. The diameter of the larger end is about half an inch, and that of the smaller about a quarter of an inch.

This borer is not generally known, those of Plattner being the only instruments of the kind in general use. These have the advantage of making a hole more quickly, and they never leave a core, which, in the case of the tubular borer, has to be removed afterwards with some care. Plattner's large borer gives a cavity with a rounded bottom like that of a crucible, which is often an advantage. These borers of Plattner are somewhat expensive, and also quite difficult to make, so that if a chemist was in a locality where they could not be bought he would not find it an easy matter to make them for himself.

I have been using, for several years, a form of charcoal borer which works with great rapidity and perfection, and which is of the easiest construction. The holes made by this borer are cylindrical, or slightly conical, with flat bottoms. Quite lately I have devised another form which gives cavities with curved bottoms like Plattner's large

borer, and which is also of the simplest construction, so that any one may, with little trouble, make one for himself.

The first of these forms is the conical tin tube of Berzelius, with two modifications, one of which consists in making each base of the tube not a complete circle, but

Fig. 3.

about three-quarters of a circle, as represented in Fig. 3, the object of which is to facilitate the removal of the core, as will be explained. The other is that the edges of each end are not like the edge of a knife, as in the tube of Berzelius, but like the edge of a saw.

Fig. 4.

Fig. 5.

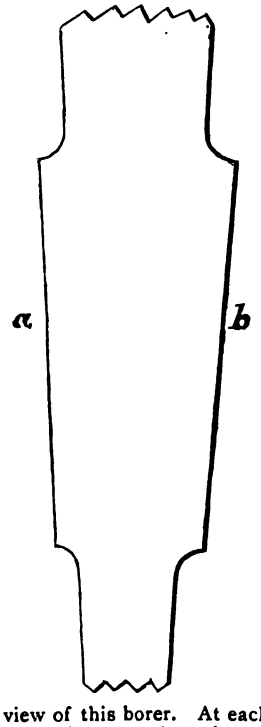


Fig. 4 represents a side view of this borer. At each end of the tin tube it may be seen that a portion, about a quarter of the metal, has been cut away. The middle portion of the tube is left entire, and the edges at this portion should be brazed or soldered together to ensure stiffness. Fig. 5 shows the shape of the sheet metal from which the borer is made. The edges *a* and *b* are to meet or overlap, and are to be brazed or soldered together.

This borer gives well-shaped holes with remarkable quickness. When the hole has been made deep enough the core is easily detached by pressing the tube against it, so that the core is pushed into the free portion of the groove, which corresponds to the part which has been removed from the conical tube.

If a borer of this kind is made with a large diameter, so as to leave a thick core which is not easily detached, a smaller hole may be bored in the core with a smaller instrument, after which the core is easily broken up and removed.

By alternately bending the teeth at the bases of the cone outwardly and inwardly, as in the operation called *setting* for carpenter's saws, a wider groove is left around the core, which is more easily detached when the borer is of large size.

The charcoal borer which gives cavities with curved bottoms is made by cutting a plate of metal so as to give it the shape shown in Fig. 6, and bending over perpendicularly to the surface of the plate the portions at each end

Fig. 6.

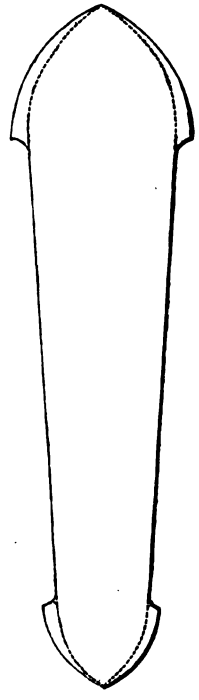


Fig. 7.

which project beyond the dotted line. These projections are bent in opposite directions, as shown in Fig. 7. The dotted lines which show the outline of the borer form an ogive, which gives a good-shaped cavity. The portion beyond the dotted line which is bent perpendicularly to the face of the plate, as we have already said, should have its edges sharpened with a file, to enable the borer to work more rapidly.

By pressing this borer against a piece of charcoal, and turning it alternately to the right and to the left, a good cavity is obtained in a very short time. Borers of this kind should be made of pretty stout metal, as otherwise they become twisted by use. Tin plate known in the trade as *three cross* is sufficiently thick for the purpose.

III. *Sheet-Iron Supports.*

I have been using for some time pieces of sheet-iron for supporting substances before the blowpipe flame. Sheet-iron presents several advantages for this purpose, in being very common everywhere, in costing little or nothing, and in being durable, so that the same piece may be used over and over again many times. We cannot on a plate of this kind exhibit the action of fluxes which attack iron, but we may see with distinctness the rings or deposits that are given before the blowpipe flame by antimony, zinc, bismuth, &c.

We may also obtain copper, lead, silver, tin, bismuth, &c., in the metallic state by the reducing flame, particularly in presence of carbonate of soda or cream of tartar.

To use sheet-iron as a support it must, in the first place, be rubbed with a piece of pumice or of Bath-brick

and water, until the plate looks bright. Thereby all dirt left by a previous operation and all rust are removed. Before placing anything for testing on the plate it is advisable to blow the blowpipe flame on it for a few seconds, when it becomes covered with a shining dark grey coat of magnetic oxide, on which the rings or deposits are seen with distinctness. We may, if we think preferable, cover the plate with a coat of soot, by holding it in the flame of a lamp or candle. On this coat the deposits take place equally well.

I generally use the thinnest sheet-iron obtainable, which is the kind on which are taken the photographs called *ferrotypes*. Sheets of this thickness are easily bent into any convenient shape. They may be used over and over again without any perceptible diminution of their thickness.

Iron has the advantage of being relatively a poor conductor of heat, which property enables us to hold in the hand one end of a piece of sheet-iron not more than 4 inches long, while the other end is in the blowpipe flame. If a handle is found necessary, the piece of sheet-iron may be held in a cork provided with a cut in which to insert it.

If we should want to use charcoal, I may point out that we can use a metallic plate as a charcoal holder, by making two slits crossing each other at right angles, and bending the four tongues obtained in this way, about perpendicularly to the surface of the plate. In a hole thus made in the plate it is an easy matter to hold tightly a small piece of charcoal by bending the four tongues more or less. The ring formed by the action of the flame may extend beyond the charcoal on the metal plate. This is in imitation of the plan proposed by Prof. Le Neve Foster, of using a plate of unglazed porcelain provided with a cavity for holding a piece of charcoal.

We may, instead of this, make a cavity in a piece of sheet-iron by indentation, and fill it with a paste made by mixing the substance to be tested with an excess of charcoal powder or black flux and a little water. After heating the mass, we may obtain the metallic particles by triturating in a mortar with water, and washing away the residuary carbon. If deposits are formed they will be found on the sheet-iron around the cavity.

IV. *Alloys of Lead and Tin.*

The reactions presented by alloys of lead and tin before the blowpipe flame are of such interesting nature that I need no apology for bringing them to your attention. I am not aware that the behaviour of these alloys has been specially noticed, with the exception of a brief note in an excellent paper, by Prof. Chapman, of the University of Toronto, "On some Blowpipe Reactions," in CHEMICAL NEWS (vol. xxxv., p. 13). In the ninth section of this paper, relating to alloys, occurs the following :—"*Lead and tin* unite readily, but the globule commences immediately to oxidise, throwing out excrescences of white and yellow oxide. On removal from the flame it still continues in ignition, and pushes out further excrescences. The unoxidised portion, if any, is malleable."

The reactions presented by alloys of these two metals had already attracted my attention when this note was published, as I wrote at the time to Prof. Chapman, in the course of a lively but very friendly correspondence on the occasion of his strictures on Turner's test for boracic acid.

The following experiments illustrate the points of interest in alloys of lead and tin: they were all tried with 6 decigrms. of alloy made from pure lead and pure tin :—

Experiment 1.—Melted together 3 decigrms. of lead and 3 decigrms. of tin. By continuing the heat before the blowpipe the alloy gives small bunches of excrescences, resembling cauliflowers. After a while the excrescences increase progressively as the blowing continues. They are at first white, afterwards yellowish. Finally, the whole mass resolves itself into cauliflowers of deep orange colour. During the formation of these excrescences copious white and yellow fumes are given out and deposited on the charcoal.

Exp. 2.—The 6 decigrms. of alloy are formed of 4 of lead and 2 of tin. In this case the reaction is violent from the very first. The bunches of cauliflower, of a deep yellow colour, are formed as soon as the metals are heated. On ceasing to blow, the reaction goes on in a lively manner. Thick fumes are given out and deposited on the charcoal.

Exp. 3.—The 6 decigrms. are formed by taking 4 of tin and 2 of lead. In this case the cauliflowers only begin to form in small bunches of white colour after persistent blowing. Fumes are given out slowly, and a malleable button is left.

Exp. 4.—Lead, 5 decigrms.; tin, 1 decigrm. After blowing a short time the deep yellow cauliflowers form, until the whole mass is oxidised. The reaction is apparently less violent than in Exp. 2.

These experiments show that when the lead is double of the tin the reaction takes place with more energy than with any other proportions. This is worthy of attention, because the atomic weight of lead (207) is nearly double of the atomic weight of tin (118). It makes it probable the deep yellow cauliflower-like excrescences are a stannate of lead. These reactions, with an alloy in which the weight of the lead is double that of the tin, also show that this alloy, when heated, absorbs oxygen with exceeding avidity, which fact may find future applications.

Although an alloy of these proportions absorbs oxygen with great avidity, Experiment 4 shows that an excess of lead does not seem to interfere in a marked degree with the reaction.

Experiments 1 and 3 were made with excess of tin, which, contrary to what takes place with lead, interferes with the formation of the excrescences.

In Experiment 3 the tin was in large excess, and the reaction was very indistinct.

A point of interest in connection with these reactions is, that although tin does not give any fumes, and that those given out by lead are very slight, alloys of these two metals give fumes which are excessively abundant, and which might mislead a person who is not on his guard to believe that zinc or antimony are present.

As both lead and tin are ordinary blowpipe reagents it may be as well to suggest that, when either of these bodies is suspected in a metallic substance to be tested, the addition of the other may furnish useful evidence. As the specific gravity of lead is 11·4 and that of tin 7·5, we may, without weighing, get approximately at the quantity of either of these metals to be added, by estimating the volume.

As an application of the foregoing I may mention that the bright foil called tin-foil—which is so extensively used in this country for wrapping around substances to be used for food—must, from its behaviour before the blowpipe, contain about twice as much lead as tin. I have not determined these proportions quantitatively.

In some works on the blowpipe it is mentioned that when a button of tin is strongly heated before the blowpipe, it continues to burn after the flame is withdrawn. I have never been able to obtain this reaction with pure tin, but it takes place readily when lead is present with the tin in sufficient quantity. The tendency to oxidation is so great in a button of alloy in which the weight of lead is double that of tin, that I do not believe that even the most expert operator would be able to keep a button of this kind from oxidation in the most perfect reduction flame that could be obtained.

V. *Reactions for Iodides, Bromides, and Chlorides.*

Several years ago Von Kobel observed that when sulphide of bismuth is heated on charcoal with iodide of potassium, a bright red coat of iodide of bismuth is obtained. From this he proposed a mixture of equal parts of sulphur and of iodide of potassium for the detection of bismuth, which he succeeded in finding in a mineral,

accompanying joseite, in which it had never been suspected. Prof. Cornwall, shortly after, proposed the same reaction for the detection of bismuth in presence of lead and antimony.

The ready formation of iodide of lead, by heating a plumbic compound with the mixture of sulphur and iodide of potassium, induced me to try the detection of iodine by heating an iodide with powdered galena. The characteristic yellow coat of plumbic iodide is deposited as soon as the flame touches the mixture. By heating chloride of sodium with galena an abundant white coat of oxychloride (?) of lead is deposited. With bromide of potassium and galena a white deposit of plumbic oxybromide (?) is obtained. When iodides, bromides, and chlorides occur together it is not possible to separate them by the use of galena, as a yellowish white coat is deposited when an iodide is mixed with either a bromide or a chloride, from which I have found it impossible to separate the yellow from the white.

If, however, instead of galena, we use a mixture of sulphur and bismuth, in connection with a mixture of an iodide with a chloride, we will obtain a yellowish coat, and beyond this red streaks. At first this result is not very promising, as the yellowish deposit resembles a mixture of iodide of lead with chloride of lead. But if we let the plate cool, and afterwards heat the yellowish deposit very slowly and carefully, the yellowish coat will separate into an outer ring of bright red iodide of bismuth, and an inner ring of oxychloride (?) of bismuth, which on cooling becomes perfectly white.

If we try the same experiment with a mixture of bromide and iodide the result is not quite so satisfactory, for although the yellowish coat—resembling that of the preceding case—becomes white on heating, the heat necessary for this causes the iodide of bismuth to be driven beyond the plate, and, although the red fumes are distinctly seen to escape, the red iodide does not remain as a witness on the plate. We may, however, by using an open tube, and by placing the mixture to be tested at one end of this tube, drive the mixed fumes of oxybromide (?) and iodide of bismuth up the tube. If afterwards we heat slowly and carefully the deposit near the end of the tube to which heat was previously applied, the white oxybromide (?) will remain, and the bright red fumes of the iodide will be driven further up the tube and deposited on its sides.

By means of a mixture of sulphur and bismuth we may, then, separate iodine from bromine and chlorine, but the separation of bromine and chlorine from one another is not possible with sulphide of bismuth.

THIRD REPORT

ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

(Continued from vol. xxxvi., p. 47).

Estimation of Potash.

Although the process of determining potassium by precipitation with chloride of platinum is the method almost universally adopted by chemists of large experience in the assay of commercial potash salts, the Committee thought it desirable to investigate also the volumetric method of Stolba, which is based on the precipitation of potassium as silico-fluoride and the titration of the precipitate with standard alkali, according to the equation—

$$K_2SiF_6+4KHO=6KF+H_4SiO_4.$$

This process is thus described on page 176 of the seventh English edition of Fresenius's "Quantitative Analysis":—

"To the moderately concentrated solution of the potash salt in a beaker add a sufficiency of hydro-fluosilicic acid, and then an equal volume of pure strong spirit. The silico-fluoride of potassium will separate as a translucent precipitate. When it has settled, filter, wash out the beaker with a mixture of equal parts strong spirit and water, and wash the precipitate with the same mixture till the washings are no longer acid to litmus paper. Put the filter and precipitate into the beaker previously used, treat with water, add some tincture of litmus, heat to boiling, and add normal alkali solution till the fluid is just blue, and remains so after continued boiling."

With a view of preparing pure chloride of potassium for these researches, the Committee abandoned the method employed last year in favour of a simpler process suggested in a note appended to the last report:—

Commercial chlorate of potassium was re-crystallised and heated until no more oxygen was evolved, and the product was dissolved in water, filtered, a few drops of hydrochloric acid added to the clear solution, and the whole evaporated to dryness, and ignited in a muffle at a low red heat. The product was powdered and bottled. When heated on clean platinum wire in a Bunsen flame it gave no trace of yellow colour to the flame.

35 grms. of this pure salt were dissolved in 315 grms. of pure water, in order to make a solution containing exactly one-tenth of its weight of pure chloride of potassium.

In the following investigation a roughly measured quantity of this solution was run into a beaker and the exact weight taken. This method was adopted during the experiments of last year in preference to pipette measurements which were not considered satisfactory. The solution was first analysed by precipitation by nitrate of silver. The following table shows the quantities taken and the number of parts of KCl found for one hundred taken.*

Number of Expt.	Weight of Solution.	Weight of AgCl.	KCl Found.	KCl found for 100 pts. taken.
A.	7·0805	1·3619	0·70850	100·06
B.	7·0275	1·3509	0·70278	100·00

The six following experiments were made by adhering strictly to the description of the process already quoted. A quantity of potassium chloride solution, containing about 0·7 grm. or 10 grms. of the salt, was used in each case. The standard alkali employed was very carefully prepared, and was strictly normal. It was not found practicable to wash the precipitate till the washings were no longer acid to litmus. The washing was therefore arrested when the filtrate gave no reaction with nitrate of silver:—

Expt.	Weight of Solution.	C.c. normal Alkali used.	KCl found per 100 pts. taken.
1.	7·1155	18·80 S.	98·54
2.	7·1100	18·83 P.	98·80
3.	7·0290	18·75 S.	99·90
4.	7·0190	18·75 S.	99·62
5.	7·1365	19·10 S.	99·56
6.	7·0210	18·70 P.	99·34

Although it was not to be expected that there could be any advantage in employing caustic potash in the titration instead of caustic soda, it was considered that the case was one in which it was just possible that there might be a choice, and therefore both alkalies were tried. The alkali employed in each experiment is distinguished by the letters P and S placed after the number of centimetres of normal alkali required.

* Report of a Committee of Section B., British Association, consisting of B. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen. Presented at the Plymouth meeting.

* The following are the atomic weights employed in the investigation:—K=39·137; Si^{IV}=28; Ag=107·93; Cl=35·457; F=18·96.

In experiment 1 an excess of alkali was employed, and the liquid was then titrated back with sulphuric acid. It was hoped in this way to ensure the complete and speedy decomposition of the silico-fluoride, but the end of the reaction was very difficult to read, perhaps owing to the formation of silicate. It was also found to be no advantage to add the acid in sensible excess, and again titrate with alkali. In some cases decinormal alkali was employed towards the conclusion of the titration, but the end of the reaction is not sufficiently defined to make the precaution valuable. No. 2 can scarcely be considered a test experiment, for the precipitated silico-fluoride was dried on the filter, and then scraped off.

The next three experiments were made on about 1·5 grms. (twice the former quantity) of potassium chloride, the precipitated silico-fluoride being dried on the filter, scraped off, and weighed.

Expt.	Weight of Solution.	Weight of Precipitate.	KCl found per 100 pts. taken.
7.	15·0525	2·2150	99·77
8.	15·0475	2·2115	99·64
9.	15·0365	2·2070	99·52

These results do not show any great departure from the truth, especially as traces of the precipitate probably adhered to the filter, and were thus lost. The manipulation was very easy, filtration occurring rapidly, and the precipitate being easily washed, dried, and separated from the filter.

After weighing, the precipitates obtained in the last experiments were suspended in boiling water, and titrated with normal alkali, with the following results:—

Expt.	Weight of Precipitate taken.	C.c. normal Alkali used.	K_2SiF_6 found per 100 pts. taken.
7. A.	2·2150	39·60 P.	98·40
8. A.	2·2115	39·60 S.	98·60
9. A.	2·2070	40·10 S.	99·95

In the last experiment the titration was slightly overdone. It appears, therefore, that the volumetric method gives results sensibly below the truth. Probably the error was greater in the last three experiments owing to the precipitates having been dried, and thus reacting less readily with alkali than the undried silico-fluoride. In these as in all other experiments the alkali was added very slowly towards the end of the reaction, and the liquid was well boiled after each addition.

Three more experiments by direct titration of the silico-fluoride with alkali gave the following results:—

Expt.	Weight of Sol. taken.	C.c. of normal Alkali used.	KCl found for 100 pts. taken.
10.	15·0525	40·10 P.	99·4
11.	15·0475	39·90 S.	98·9
12.	15·0365	40·10 S.	99·4

In these last experiments the large quantity of silica produced rendered the end of the reaction difficult to observe. In fact, the want of sharpness in the termination of the reaction is a serious defect of the process. A porcelain basin was found preferable to a beaker for conducting the titration.

Although in the above experiments the volume of alkali used was read to one-twentieth of a cubic centimetre, the end of the reaction could not be defined so closely, even after considerable practice. A difference of 0·1 c.c. in the volume of the standard alkali employed corresponds in the last three experiments to about 0·25 per cent of the chloride of potassium taken, and in the first six experiments to 0·5 per cent of the sample. As the quantity of potassium chloride worked on cannot be conveniently increased beyond the weights used in experiments 10, 11, and 12, it is evident that the process is not susceptible of great accuracy, even if no other disturbing influences existed.

The fact that the volumetric method gives results below the truth is probably due to the difficulty of decomposing the last traces of silico-fluoride by alkali without introducing an excess of the latter. The trace of free alkali which suffices to change the tint of the litmus to blue seems incapable of reacting on the silico-fluoride. An attempt was made to overcome this difficulty by adding a sensible excess of alkali, boiling well, and titrating back with standard acid, but the result was not satisfactory, the end of the reaction being very obscure.

In practice it would be preferable to set the standard alkali by its action on moist silico-fluoride prepared from a known quantity of potassium chloride rather than to trust to its theoretical neutralising effect.

As the drying and weighing of the silico-fluoride requires but little more time than the titration with alkali, and gives better results, the gravimetric estimation is to be preferred. Although the process is not to be compared in accuracy to the precipitation and weighing of potassium as chloro-platinate, it might no doubt be advantageously employed in particular cases.

The next experiments were made on a mixture of 75 per cent of chloride of potassium with 25 per cent of chloride of sodium:—

Expt.	Weight of KCl Sol. taken.	NaCl taken.	C.c. normal Alkali used.	KCl found for 100 pts. taken.
13.	11·7505	0·375	42·95 S.	136·3
14.	11·7530	0·375	42·95 S.	136·3

These results show that 96·9 per cent of the total amount of alkali metal present was precipitated as silico-fluoride. In two other experiments of equal weights of potassium and sodium chlorides, 222 and 218 parts of KCl were found for 100 parts taken. The former number represents a precipitation of 96·8 per cent of the sum of the alkali metals present.

Two experiments were next made on mixtures of potassium and sodium chlorides by precipitating the solution with hydro-fluosilicic acid as before, but using a smaller proportion of spirit. One-third of the bulk of solution and wash-water consisted of rectified spirit, instead of one-half as in all previous experiments. The weights of the precipitates corresponded respectively to 169 and 188 parts of potassium chloride for 100 parts taken.

It is evident from these experiments that the process is quite worthless for the separation of potassium from sodium, and consequently that the number of cases in which it can be advantageously employed is greatly limited. Although this result was anticipated from the known properties of sodium-silico-fluoride, it was thought desirable to establish the fact by direct experiment.

Since the above experiments were completed the original paper of Stolba has been consulted. The author recommends the suspension of the precipitated silico-fluoride in a much larger quantity of water than was employed in the above experiments. This plan would cause the more perfect solution of the precipitate and probably yield somewhat higher results, but the author's experiments on pure potassium salts gave results sensibly below the truth. As the value of the process is greatly limited by its uselessness in the presence of sodium compounds, the Committee did not think it necessary to perform a fresh series of experiments with more rigid adherence to Stolba's directions.

(To be continued.)

Ferruginous Colouring Matter of Red Wines.—A. Gautier.—The indigo-blue colouring matter mentioned by the author, *Comptes Rendus*, lxxxvi., p. 1507, contains more than 3·5 per cent of iron, and behaves in all its reactions as the ferrous salt of a red bibasic acid, slightly soluble in water, astringent, and very analogous to a tannin. M. Maumené, though he has not analysed this compound, seems to doubt the presence of iron in it. The œnocyanine of Mulder is probably the impure ferrous salt of one of the red colouring matters of wine.—*Comptes Rendus.*

EDISON'S MICRO-TASIMETER.

We are indebted to Mr. Edison for the following illustrated account of his latest invention, viz., the micro-tasimeter, or measurer of infinitesimal pressure.

The *Scientific American*, in which the account Mr. Edison sends us has already appeared, remarks that the thermopile, hitherto foremost among delicate indications of changes of temperature, must now be consigned to the rear ranks, and the radiometer, which exhibits the motive power of the most subtile of forces, must retire in favour of an instrument that can weigh that force.

The micro-tasimeter is the outcome of Mr. Edison's experiments with his carbon telephone. Having experimented with diaphragms of various thicknesses, he ascertained that the best results were secured by using the thicker diaphragms. At this stage he experienced a new difficulty. So sensitive was the carbon button to changes of condition, that the expansion of the rubber telephone handle rendered the instrument inarticulate, and finally

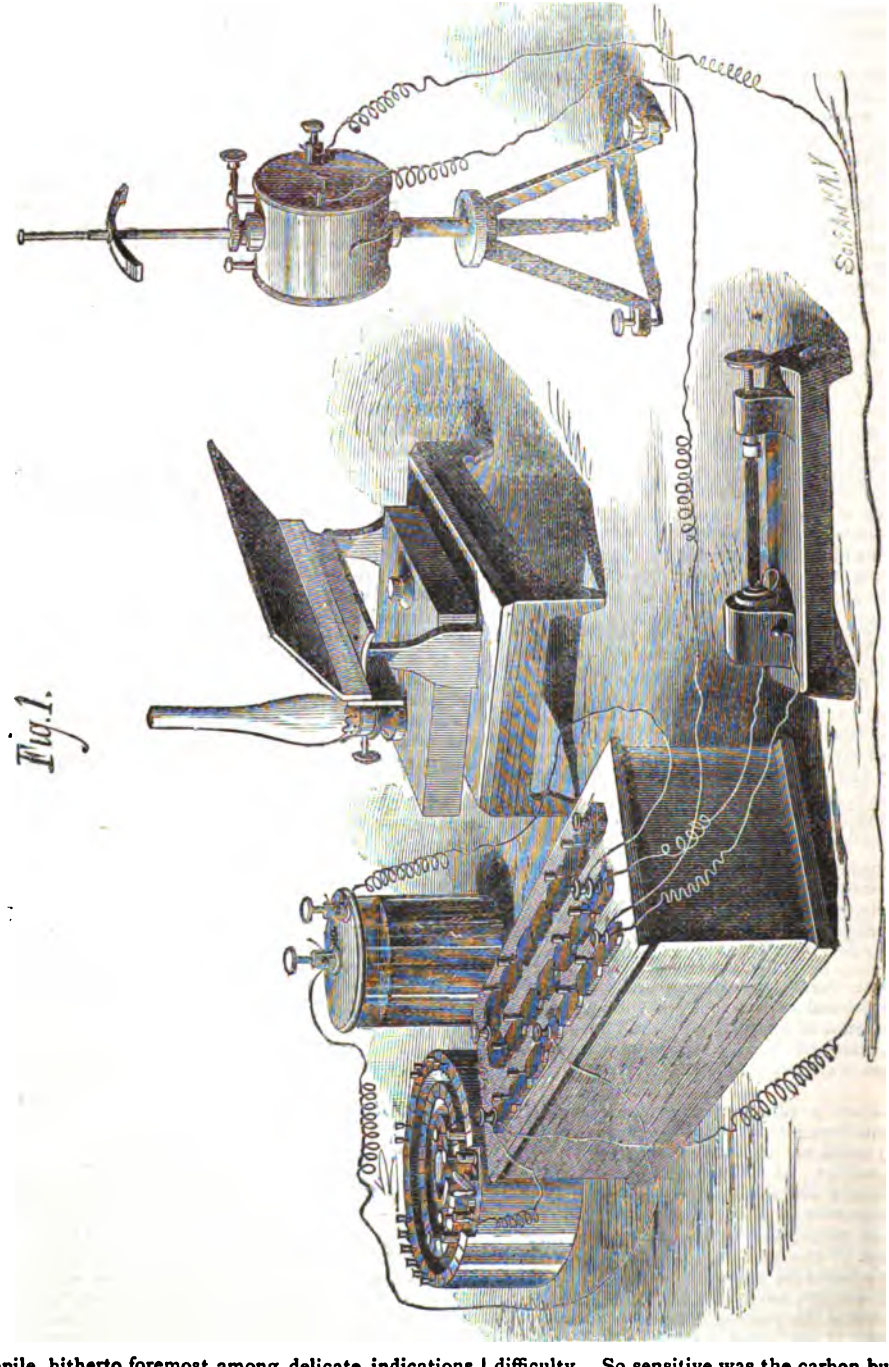


Fig. 1.

EDISON'S MICRO-TASIMETER.

inoperative. Iron handles were substituted with a similar result, but with the additional feature of musical and creaky tones distinctly audible in the receiving instrument. These sounds Mr. Edison attributed to the movement of the molecules of iron among themselves during expansion. He calls them "molecular music." To avoid these disturbances in the telephone the handle was dispensed with; but it had done a great service in revealing the extreme sensitiveness of the carbon button, and this discovery opened the way for the invention of the new and wonderful instrument.

The micro-tasimeter is represented in perspective in Figs. 1 and 2, in section in Fig. 3, and the plan upon which it is arranged in the electric circuit is shown in Fig. 4.

The instrument consists essentially in a rigid iron frame for holding the carbon button, which is placed between two platinum surfaces, one of which is fixed and the other movable, and in a device for holding the object to be tested, so that the pressure resulting from the expansion of the object acts upon the carbon button.

Two stout posts, A B, project from the rigid base piece, C. A vulcanite disk, D, is secured to the post, A, by the platinum-headed screw, E, the head of which rests in the bottom of a shallow circular cavity in the centre of the disk. In this cavity, and in contact with the head of the screw, E, the carbon button, F, is placed. Upon the outer face of the button there is a disk of platinum foil, which is in electrical communication with the battery. A metallic cup, G, is placed in contact with the platinum disk to receive one end of the strip of whatever material is employed to operate the instrument.

The post B is about 4 inches from the post A, and contains a screw-acted follower, H, that carries a cup, I, between which and the cup G is placed a strip of any substance whose expansibility it is desired to exhibit. The post A is in electrical communication with a galvanometer, and the galvanometer is connected with the battery. The strip of the substance to be tested is put under a small initial pressure, which deflects the galvanometer needle a few degrees from the neutral point. When the needle comes to rest its position is noted. The slightest subsequent expansion or contraction of the strip will be indicated by the movement of the galvanometer needle. A thin strip of hard rubber, placed in the instrument, exhibits extreme sensitiveness, being expanded by heat from the hand, so as to move through several degrees tht needle of a very ordinary galvanometer, which is not affected in the slightest degree by a thermopile facing and near a red-hot iron. The hand, in this experiment, is held a few inches from the rubber strip. A strip of mica is sensibly affected by the heat of the hand, and a strip of gelatin, placed in the instrument is instantly expanded by moisture from a dampened piece of paper held 2 or 3 inches away.

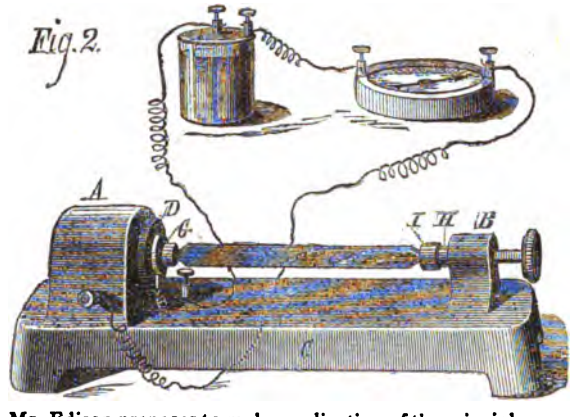
For these experiments the instrument is arranged as in Fig. 2, but for more delicate operations it is connected with a Thomson's reflecting galvanometer, and the current is regulated by a Wheatstone's bridge and a rheostat, so that the resistance on both sides of the galvanometer is equal, and the light-pencil from the reflector falls on 0° of the scale. This arrangement is shown in Fig. 1, and the principle is illustrated by the diagram, Fig. 4. Here the galvanometer is at *g*, and the instrument which is at *i* is adjusted, say, for example, to ten ohms resistance. At *a*, *b*, and *c* the resistance is the same. An increase or diminution of the pressure on the carbon button by an infinitesimal expansion or contraction of the substance under test is indicated on the scale of the galvanometer.

The carbon button may be compared to a valve, for, when it is compressed in the slightest degree, its electrical conductivity is increased, and when it is allowed to expand it partly loses its conducting power.

The heat from the hand, held 6 or 8 inches from a strip of vulcanite placed in the instrument—when arranged as last described—is sufficient to deflect the galvanometer-mirror so as to throw the light-beam completely off the scale. A cold body placed near the vulcanite strip will carry the light-beam in the opposite direction.

Pressure that is inappreciable and undiscoverable by other means is distinctly indicated by this instrument.

Fig. 2.



Mr. Edison proposes to make application of the principle of this instrument to numberless purposes, among which are delicate thermometers, barometers, and hygrometers. He expects to indicate the heat of the stars and to weigh the light of the sun.

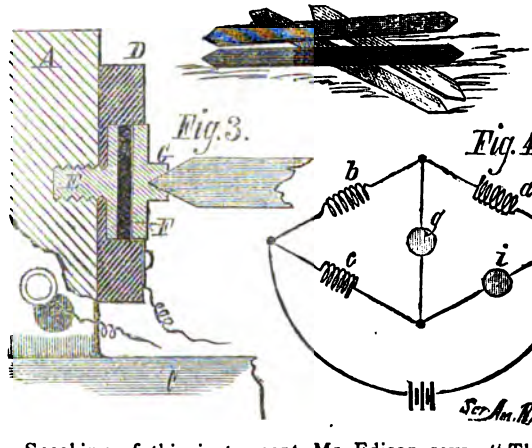


Fig. 3.

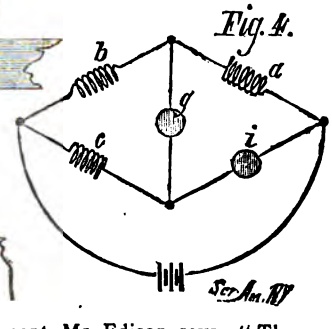


Fig. 4.

Speaking of this instrument, Mr. Edison says—"The heat-measurer was described and experiments shown to Professor Langley, the well known astronomer of the Alleghany Observatory, some six months ago. On his suggestion at the time, that it ought to be worked up as a very valuable boon to science, especially in the line he was investigating (that is, measuring the heat of the stellar spectra), I tried many experiments with it, and devised the form given. This apparatus was described to various members of the National Academy of Sciences, held at Washington, April 17, 18, and 19, 1878, and the Washington *Star* and *Union* newspapers published then gave a description of the instrument. Copies of these papers were at once mailed to William H. Preece, Prof. Schellen, Count du Moncel, and other physicists in Europe."

The Special Correspondent of the *Daily News*, at Rawlings, Wyoming, in his account of the Eclipse of the Sun on the 29th ult., says:—

"The tasimeter, the new instrument on which Professor Edison has been working unceasingly here, has proved its delicacy. During the eclipse he attached Thomson's galvanometer, the index being set to zero, when the telescope carrying the tasimeter was pointed several degrees from the sun. The point of light rapidly left the scale, when the corona was brought upon the fine slit by which

the tasimeter itself was protected. There was no chromosphere to speak of, and only one prominence, like the horn observed in 1868, but very dim."

CORRESPONDENCE.

DETECTION OF NITRIC ACID.

To the Editor of the Chemical News.

SIR,—I have lately ascertained that Sprengel anticipated me some time back in the application of carbolic and sulphuric acids for the detection of nitric acid, but his method of applying the reagents is different to the one I proposed. The latest edition of Fresenius contains a description of this test, and perhaps some editions not so recent as this, as I find it also in Galloway's "Manual of Qualitative Analysis," fifth edition. Both these works have only reached me lately.—I am, &c.,

DAVID LINDO.

Falmouth, Jamaica, July 8, 1878.

THE ESTIMATION OF TANNINS.

To the Editor of the Chemical News.

SIR,—I shall be glad if you will afford me space for a brief note upon the article by Mr. H. R. Procter upon the "Estimation of Tannins," in the CHEMICAL NEWS, vol. xxxvii., p. 256. In this article Mr. Procter claims for Lowenthal the whole of the very quick and accurate method now employed to estimate the *tannic only*, when, as is usually the case, it co-exists with gallic acid. May I call your attention to the fact that in the CHEMICAL NEWS, vol. xxix., p. 109, appeared an article by me upon "Tea Analysis," in which I distinctly lay down the method (giving Lowenthal the credit due to him). It depends solely upon the precipitation with gelatin of the whole of the tannin in the compound under examination, and a titration with permanganate of potassa (with indigo as indicator), both before and after precipitation. For the special work I was doing it suited admirably, and performed in the cold, and with Lowenthal's additions of salt and acid in excess, is very accurate.—I am, &c.,

C. ESTCOURT.

The Analytical Sanitary Institution,
8, St. James's Square, John Dalton Street,
Manchester, July 30, 1878.

WORKING UP OF NAPHTHALIN FOR USEFUL PRODUCTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxviii., p. 18), I read a letter of Mr. Watson Smith criticising my paper about naphthalin, some comments on which appear necessary to me.

Mr. Watson Smith takes exception to the form in which the discussion of naphthalin has been delivered, and seems not to agree with my having referred to the original sources and a number of patents. If Mr. W. Smith would kindly glance at the little preface of my papers on "Dyers' Chemicals" he would see that it was not my intention to deliver a complete theoretical paper, but only to give a short and intelligible *resumé* of the present state, the practical and theoretical questions, &c., of the principal tar products. The paper should be in a form in which it might have interest for non-chemists as well, and principally for these; and for this purpose I thought the quoting of "blue books" and patents desirable.

The principal point of the above-mentioned letter, however, is Mr. W. Smith's complaint about my having taken up his field of research, "which honourably should be left to the worker." I can assure Mr. W. Smith that I fully acknowledge the existence of an "international understanding," and would be the last one to interfere with the researches on a theoretical problem of one of my colleagues. But I think, at the same time, that common sense has to be admitted as well for the forming of exceptions to the rule. It would be quite absurd to isolate questions of great importance for this industry by including them in this matter of etiquette, and to leave them entirely to the comfortable working of a single individual. Since the beginning of the manufacturing of artificial dyes, the naphthalin problem was *a*, or, better, *the* principal question being worked at by a great many chemists of this branch. What an enormous influence the solution of the naphthalin theme would have upon the whole coal-tar industry it is useless to mention. And such a burning question should be monopolised by a mere matter of etiquette? It should be left to the leisure of *one* man, who, by publishing results of some experiments, would keep the subject to his own use, at the same time perhaps convincing everybody by his non-results that in the ways he is following up a desirable deliverance of the question is not likely to be expected soon.

One thing, however, strikes me in Mr. Watson Smith's phillippics. Since Laurent, or even Garden, in 1820, brought the first notes about the coal-tar naphthalin, that body has continually been worked at by a number of chemists. When Mr. W. Smith, "eight or nine years ago," began his researches on naphthalin he must have been aware of this subject being taken up by several of his colleagues, of whom I will only quote Messrs. Berthelot, E. Kopp, Vohl, and Ballo. It may well be asked how Mr. W. Smith, with his view of the case, could conscientiously interfere with the work of the above most eminent chemists?—I am, &c.,

J. MARZELL.

41, Woburn Place, Russell Square,
London, W.C.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 2, July 8, 1878.

Action of Heat upon Aldol.—A. Wurtz.—The principal product is crotonic aldehyd; there is also formed a small quantity of ordinary aldehyd, and under certain circumstances a new polymer of aldehyd. The decomposition is sometimes effected at 140°, but in other cases not below 180°.

Influence of Atmospheric Electricity upon the Nutrition of Plants.—L. Grandeau.—The author, after a carefully conducted series of experiments, concludes that atmospheric electricity is a preponderating factor in the assimilative process in plants. Plants withdrawn from this influence by means of a "Faraday cage" elaborate in equal times, all other conditions being equal, from 50 to 60 per cent less of living matter than those whose growth has been effected in ordinary circumstances. Plants little raised above the soil are equally affected by atmospheric electricity. The percentage of proteic matter formed does not appear to depend on the action of atmospheric electricity, but remains proportional to the total crop. The percentage of ash is higher in plants protected from electric action, but the proportion of water is higher.

Curves of Solubility of Salicylic and Benzoic Acids.—E. Bourgoin.—The author has made a great

number of determinations of the solubility of these acids at different temperatures and expresses the result by curves.

Diffusion of Fire-damp in Coal-mines.—J. J. Coquillion.—In a former paper the author showed that fire-damp does not mix readily with air, and has a great tendency to keep in the upper parts of the galleries. He now finds that it requires three or four hours to reach the lower parts, even in small quantity, and complete diffusion requires a much longer time.

Structure of Several Minerals.—M. Gaudin.—The author proposes to submit to the Académie several studies which he has made on various minerals, throwing an important light upon their composition, their intimate crystalline form, and rendering it possible to calculate—often with absolute precision—their principal angles, taking for the distance of the molecules from each other in a horizontal direction (lateral assemblage), or in a vertical direction (superposition), the atomic distance, $\sqrt{2}$ atomic distance, the double or triple atomic distance—in a word, the atomic distance multiplied by a very simple number increasing with the diameter of the molecules.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin. No. 8, 1878.

The Atomic Weight of Glucinum.—B. Brauner.—The specific heat of glucinum at temperatures between 0° and 100° = 0·4079. It is still, however, possible that the atomic weight of G = 9·2 and that its oxide is GO. It is known that a large part of the elements with a small atomic weight, such as B, C, Mg, Al, Si, PS, at low temperatures, possess a smaller specific and atomic weight than should belong to them in accordance with the law of Dulong and Petit. The same is the case with the gases H, N, O, F. All these elements are distinguished by a peculiar position in the well known table of L. Meyer, which shows the dependence of atomic volume upon atomic weight (see *Die Modernen Theorien der Chemie*, 3rd edit., p. 311). A line marked in the table as "boundary of the law of Dulong and Petit" separates these elements, which at medium temperatures do not agree with this law, from the others. It is, therefore, not improbable that, just as the elements B = 11 and C = 12 at low temperatures have atomic heats down to 2·5 and 1·7, or, between 0° to 100°, 3·1 and 2·5 instead of 6·5, so the contiguous element G (9·2) may have an atomic heat of merely 3·8, as would follow from the number found by MM. Nilson and Petersson. The results of the extensive investigations of M. Nilson on the platinum double salts of the rarer metals and their valence seem to testify that the atomic weight of G = 9·2 rather than 13·8. It appears, further, from all experiments hitherto, that all elements, not excepting the rarer earth-metals, are capable of insertion in the periodic system of D. Mendelejeff and Lothar Meyer; whilst if we assume G = 13·8 this system loses all significance, because their number almost coincides with the atomic weight of nitrogen. The author, therefore, concludes that the question of the atomic weight of glucinum can only be considered as finally decided when the vapour density of its volatile chloride has been ascertained.

Para-chlor-benzyl-chloride and its Derivatives.—C. Loring Jackson and A. W. Field.—Para-chlor-benzyl-chloride is no liquid, but forms white shining needles or prisms of a pleasant aromatic odour, and having a violent action upon the mucous membranes. Melting-point, 29°; very volatile; sublimes at common temperatures. Insoluble in water, sparingly soluble in cold alcohol, though readily in hot; very soluble in ether, benzol, sulphide of carbon, and glacial acetic acid. If boiled with water it yields para-chlor-benzyl-alcohol and hydrochloric acid.

The Atomic Weight of Glucinum: Reply to M. Lothar Meyer.—L. F. Nilson and Otto Petersson.—The authors declare that it did not escape their notice that the atomic weight of the metal, 13·8, could not be conveniently adapted to Mendelejeff's system, but expected that this would become the subject of a scientific controversy. They have described the details of their experiments and conclusions in a paper about to appear in *Poggendorff's Annalen*. At present they merely point out some possible sources of error in the experiments of Reynolds, upon which the view opposed to their own is based.

Frerich and Smith's Examination of the Salts of Lanthanum and Didymium.—P. T. Cleve.—The author considers several of the statements of Frerich and Smith completely incorrect, and considers it remarkable the values found in their analyses agree exactly with numbers calculated from inaccurate formulæ.

Difference of the Absorption Spectrum of One and the Same Substance.—Hermann W. Vogel.—In the author's memoir (*Berichte*, vi., p. 622) he has shown by several examples that under different circumstances one and the same body may give absorption spectra of totally different characters. Further investigations on this subject have shown that this peculiarity is an almost universal property of all absorbent solid and liquid bodies, whether organic or inorganic; those substances which in the solid state give the same spectrum as in solution belonging to the exceptions. Hitherto the absorption spectrum of a salt or of a colouring matter has been supposed to signify the spectrum of its solution, assuming, often without further question, that it must be identical with that of the solid body, though examples to the contrary were not unknown. This assumption can now be no longer maintained. For examining the spectra of solid salts and colouring matters the author employs thin strata obtained by evaporating a solution of the substance upon glass plates or in watch-glasses. The results obtained could not be intelligibly described without the numerous diagrams of the original memoir.

Sulphuretted Derivatives of Benzophenon.—C. Engler.—The author examines the action of ammonium sulphide and potassium sulph-hydrate upon benzophenon.

New Modes of Preparation and Certain Properties of Tetra-phenyl-ethan.—C. Engler.—The author obtains tetra-phenyl-ethan from the pinakonoid sulphide of benzophenon from the chloride of benzophenon.

Certain Derivatives of Acetophenon.—C. Engler.—An examination of the sulpho-, brom-, and amido-derivatives of acetophenon.

Behaviour of Quartz and of Silicic Acid in General with Microcosmic Salt.—E. Laufer.—Quartz is palpably attacked by microcosmic salt at a red heat. Kaolin, if melted with the salt, yielded a bead which dissolved in water with the exception of a few traces. The determination of quartz in this manner, therefore, is impracticable.

Chemical Action of Water and of Saline Solutions upon Zinc.—A. J. C. Snyders.—Zinc decomposes saline solutions, whether dilute or concentrated, without the access of oxygen, hydrogen being liberated and zinc oxide formed. The solubility of zinc oxide in the solutions accelerates the action. The solubility of the metal varies in different salts, being greatest in those of ammonia. It seems to be determined by the formation of free alkali in as far as this, at a given temperature and concentration can co-exist with a zinc double salt. Zinc hydroxide and carbonate are insoluble in carbonates. The solubility of zinc oxide increases with increasing concentration and rising temperature. When the saline solution is saturated with zinc oxide the decomposition proceeds, but the zinc oxide then formed remains undissolved. On the access of oxygen free from carbonic acid the zinc oxide dissolves more rapidly, because the zinc is oxidised at the same time. The salt promotes this action, not as such, but only because it alters the surface. On the access of atmospheric carbonic acid the solvent action is somewhat delayed on account of the formation of basic

carbonate of zinc upon the metal. The decomposing and dissolving action is strongest for the chlorides and potassium sulphate, weaker for the nitrates of the alkalies and of barium and magnesium sulphate. Zinc, if air is excluded, does not act upon solutions of alkaline carbonates and sodium phosphate. If oxygen is present little zinc is dissolved by solutions of 1 per cent, the metal being protected by the coat of zinc carbonate or phosphate formed. In more dilute solutions some zinc oxide dissolves. The effect increases with the temperature, and at 0° it is very trifling. Ammoniacal solutions take up more zinc than the salts of the fixed alkalies. Hard spring waters do not act upon zinc, even when the percentage of chlorides and sulphates is considerable. Soft waters dissolve more the more the quantity of the chlorides, sulphates, and nitrates exceeds that of the carbonates and phosphates.

Condensation Products of Tertiary Aromatic Bases.—Otto Fischer.—A preliminary notice of the respective actions of dimethyl-anilin with oil of bitter almonds, furfurol, chloral, and benzhydrol.

Glycoside of Persian Berries, and on Rhamnodulcite.—C. Liebermann and O. Hörmann.—The glycosides and colouring matters of quercitron and of Persian berries are very near to each other. Identity, however, as Hlasiwetz conjectured to exist between quercitrin and xanthorhamnin and between quercetin and rhamnetin, is out of the question if both groups of compounds are directly compared. For this purpose it is sufficient to keep in view the respective solubilities. Xanthorhamnin dissolves readily in cold water, quercitrin only at a boil, and on the cooling of the solution it is at once deposited in distinct needles. Rhamnetin is scarcely soluble in water, but quercetin much more readily.

On Phenyl-sulphocarbaminic Acid.—B. Rathke.—Phenyl-sulphocarbaminate of potassa is obtained by heating equal molecules of potassic xanthogenate and of aniline dissolved in alcohol for three or four hours with a reflux condenser. On cooling diphenyl-sulphurea separates out, whilst potassium phenyl-sulphocarbaminate is deposited from the filtrate after concentration.

On Sulphuretted Dicyan-diamin.—B. Rathke.—This substance is decomposed by salts of silver and of other heavy metals into metallic sulphide and dicyan-diamid. At 100° conversion into guanidin sulphocyanide begins.

Preliminary Communication.—B. Rathke.—The author holds that he has come upon a base bearing the same relation to guanidin as does biuret to urea, and which may be named biguanid. Dicyan-diamin is intermediate between it and biuret.

Meta-benz-bioxyanthraquinon and Anthraflavic Acid from Meta-oxy-benzoic Acid.—E. Schunck and H. Rœmer.—The composition of meta-benz-bioxy-anthraquinon is expressed by the formula $C_{14}H_8O_4$. It melts between 291° and 293°; it congeals crystalline, and burns with a very luminous flame; it sublimes, leaving scarcely any carbonaceous matter. Iso- and anthraflavic acid do not melt at 330°. It is somewhat easily soluble in alcohol with a yellow colour, and crystallises from the solution in yellow anhydrous needles. (Iso-anthraflavic acid takes up crystalline water). Easily soluble in glacial acetic acid, in which anthraflavic acid and iso-anthraflavic acid are sparingly soluble. It is insoluble in water, but soluble in benzol, ether, and chloroform with a yellow colour. The solutions show no absorption-bands.

On Cyan-guanidins (Second communication).—O. Landgrebe.—An account of the action of aniline hydrochlorate upon α-dicyan-triphenyl-guanidin; of that of toluydin hydrochlorate upon the same compound; of the behaviour of β-dicyan-triphenyl-guanidin with alkalies; and of dicyan-ditolyl-phenyl-guanidin.

Oxidation of Ditolyl-parabanic Acid.—O. Landgrebe.—The author obtains a bibasic acid by oxidising ditolyl-parabanic acid with potassium permanganate.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 54, June, 1878.

The only paper in this issue relating to a chemical subject is derived from an English source, and has been read before the Society of Arts.

La Correspondance Scientifique.
July 2, 1878.

This paper appears to be chiefly devoted to physical and engineering questions. In the present issue we notice a detailed account of the controversy between Messrs. Hughes and Edison concerning the invention of the microphone.

Reimann's Färber Zeitung,
No. 25, 1878.

This issue is chiefly devoted to a notice of the colours and dyed and printed textile goods on view at the Paris Exhibition. Joly's process for carbonising vegetable impurities in woollen cloth is to be seen in its results, and appears not to injure the more delicate colours. The shades of Tussah silk, bleached and dyed according to Girard's process, are declared to be of finished beauty. A similar display in the English department has not the finish of the colours exhibited by the French manufacturers

No. 26, 1878.

We have here a continuation of the account of the Paris Exhibition. In the English department the colours shown by Messrs. G. Lowe; L. J. Levinstein and Sons; Brooke, Simpson, and Spiller; and Williams, Thomas, and Dower are particularly noticed. The absence of any specimens of dyed furs is remarked. The American display is pronounced to offer nothing worth notice, and the same remark is applied to Sweden and Norway. A Spanish collection of shaded woollen yarns far exceeds anything similar in the French department. Australia exhibits but little, though in fine woollen yarns it falls little short of the Berlin standard. Calico-printing in Russia has made great advances by the aid of foreign skill and protective duties.

No. 27, 1878.

The Swiss display in the Paris Exhibition is very interesting. J. R. Geigy, besides the ordinary aniline colour, exhibits diphenylamin in shining scales, methyl-blue and resorcin in crystals of the average size of soda crystals. The second side of his show-case contains ground dye-woods, extracts, and indigo substitute; the third, hæmatoxylin, eosin, cyanin, &c.; and the fourth, dyed silks. P. Monnet and Co. of La Plaine, near Geneva, excel in the blue shades of eosin (phloxin and cyanosin). They exhibit, also, aniline-scarlet, and a model of the autoclave for the production of methyl-chloride. Bindschedler and Busch, of Bâle, exhibit the products of the alizarin manufacture, such as sublimed alizarin, anthracen and anthraquinon sublimed in spendid yellow crystals an inch in length; also eosin, methyl-eosin, and methyl-green in crystals of a coppery lustre. Freund and Merlanchon, of Bâle, exhibit phthalic acid in crystals eight inches long, resorcin in large crystals, fluorescein, eosin, both free and as a sodium salt (soluble in water), naphthylamin, Magdala red, nitronaphthalin, azo-dinaphthylamin, &c. Durand and Huguenin exhibit large crystals of phthalic acid, resorcin, and fluorescein, as also gallein and cœrulein, the recently discovered phthaleins of pyrogallic acid. Gerber and Uhlmann exhibit large blocks of diphenylamin and the blues produced from it; also benzyl yellow, aniline grey, &c. Great praise is awarded to the Swiss silks.

No. 28, 1878.

In concluding the account of the Paris Exhibition the editor remarks that the French are fully aware of the

superiority of the Germans in dyeing, especially in woollen goods. The general character of the Exhibition is a want of novelty. The electric light is strongly recommended for use in dye works, as it permits colours to be compared as accurately as can be done by day-light.

MISCELLANEOUS.

Anniversaries of the Birth of Sir Humphry Davy and of Gay-Lussac.—An American correspondent writes to remind us that the 17th of December is the hundredth anniversary of the birth of Sir Humphry Davy. Eleven days before, on the 6th, also occurs the hundredth anniversary of the birth of Gay-Lussac. The American Chemical Society propose to celebrate these two centennials in December, though in what manner has not yet been decided. One of these events being of special interest to English chemists, we venture to hope that it will not be allowed to pass by unnoticed. We shall be glad to receive any suggestions our readers may be able to send us with regard to the best form in which it could be celebrated in England.

Another New Metal.—According to the *Correspondance Scientifique* of July 30th, Dr. J. Lawrence Smith, Professor of Chemistry in the University of Louisville, Kentucky, has discovered a new metal belonging to the cerium group, and has named it mosandrium, after Mosander, whose researches on this class of metals are well known. The new earth mosandria, from which the metal was obtained, differs from the rest of the group of which yttria is the head by its reaction with potassic sulphate, although what this reaction is we are not informed. From cerium oxide mosandria differs by its solubility in very weak nitric acid and in alkaline solutions supersaturated with chlorine; from lanthanum by the colour of its oxide and salts, and from didymium by certain dark rays in the bright part of the spectrum. We shall refer at greater length to this discovery in our next number, giving, if possible, the physical and chemical properties of the new element.

University of London.—The following is a list of the candidates who have passed the recent First B.Sc. Examination:—*First Division.*—S. G. H. Barfield, private study; T. Beck, University College; J. A. B. Bennett, Downing College, Cambridge; G. J. Burns, Birkbeck Institute and private study; J. Easterbrook, M.A., University College; E. B. Stewart, B.A., private study; S. L. Hart, St. John's College, Cambridge; R. S. Heath, Trinity College, Cambridge; S. C. Hill, B.A., University College; T. Purdie, Royal School of Mines; E. H. Rennie, M.A. Syd., University College and Royal School of Mines; M. W. Richmond, University College; H. Somerville, University College and private tuition; J. H. Steel, private study; C. E. Stuart, University College and private study; F. L. Teed, University College and private study; J. C. Thresh, Owens College and private study; J. W. W. Waghorn, private study; J. R. Watson, Pannal and University Colleges; T. W. Williams, University College and Royal College of Chemistry. *Second Division.*—G. Haworth, T. Kernan, and A. F. Laloë, private study; W. Penhall, Trinity College, Cambridge; E. Radford and G. H. Whitelegge, University College. *Mathematics Only.*—J. W. Batterham, private study; A. H. N. Lewers, University College; J. D. E. Mortimer, Westminster Hospital.

TO CORRESPONDENTS.

J. B. Wilkinson.—(1) The remarks on "Black-dyeing" in our issue of July 12 are taken from the *Moniteur Scientifique Quesneville*, July, 1878, p. 843. (2) The aluminate of soda test serves to detect logwood in a mixture of colouring matters, but in an adulterated extract of logwood the problem is reversed. We have to detect chestnut, &c., in logwood.

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 976.

THIRD REPORT

ON THE METHODS EMPLOYED IN THE

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

MODE OF STATING THE RESULTS.*

(Concluded from p. 55.)

Methods of Determining Phosphoric Acid.

With respect to the general method of procedure in the assay of commercial phosphatic materials, the Committee has not thought it necessary to make any original experiments, the published and collected evidence on the subject being sufficient for the purpose.

As the result of a very careful consideration of the subject, the Committee make the following recommendations and suggestions. In most cases these are quite free from novelty; but as the evidence collected by the Committee and the results of many commercial analyses show that certain considerations and precautions are in many cases partly or wholly neglected, the Committee is of opinion that the general adoption of the following suggestions would tend greatly to diminish the number and extent of the discrepancies common in determinations of phosphoric acid.

Solution of the Manure.

The Committee is of opinion that for dissolving the soluble phosphate contained in a manufactured manure its water should invariably be employed. The water should be employed in successive small quantities, and the treatment and digestion with the solvent should not be extended over more than two or three hours. Hot water should be wholly avoided, both for the original extraction of the soluble matter and for washing the residue.

The neglect of the above precautions may cause an error in either direction. The effect of employing hot water for dissolving the soluble phosphate is shown by the fact that the cold aqueous extract of many superphosphates yields a precipitate on boiling. On the other hand, the di- and tricalcic phosphates undergo change on boiling with water, with partial solution in some cases.

For the solution of the portion of the manure insoluble in water, or for the determination of the total phosphoric acid, hydrochloric acid is the most suitable. In manures containing iron the addition of a few drops of nitric acid is desirable to ensure the complete peroxidation of any ferrous compound which may be present.

In manures containing silica the evaporation of the acid solution to dryness should never be omitted. The neglect of the precaution causes the precipitation of the silica at a subsequent stage, and is liable to cause a serious error. Another advantage of the evaporation to dryness is the partial elimination of any fluorine which may be present.

In cases in which much organic matter is present, iron and aluminium cannot be precipitated satisfactorily. In such cases the original sample or the residue insoluble in water should be ignited with an alkaline oxidising mixture before treating it with acid.

* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen. Presented at the Plymouth meeting.

Fresenius, Neubauer, and Luck* have recommended the employment of dilute sulphuric acid for the extraction of the total phosphoric acid from a manure. The advantage claimed for this modification is that the iron and aluminium remain chiefly undissolved. As, however, a small and not very constant amount of iron undergoes solution, the advantage of this method is considerably diminished.

Separation of the Iron and Aluminium.

In all cases in which more than traces of iron or aluminium are present, the Committee is strongly of opinion that they should be separated. In the first place, several of the most satisfactory methods of determining phosphoric acid are vitiated by the presence of these metals; and, secondly, the manurial value of the sample is affected by their presence. It is therefore doubly important that they should not be ignored.

The removal of the aluminium and iron from the solution is readily effected by neutralising any excess of acid with ammonia and adding ammonium acetate, when iron and aluminium are thrown down as phosphates, which may be filtered off and weighed. The operation should be conducted in a cold or but slightly warm solution. If the liquid be heated a calcium phosphate is thrown down.

The Oxalic Acid Method.

In employing this method it is very desirable to previously separate iron and aluminium acetate. Besides the advantages already mentioned, this precaution renders it unnecessary to add an organic acid before precipitating the phosphate with magnesia. The use of an organic acid prevents the complete separation of the lime, oxalate of calcium being soluble in citrate of ammonium, and tends to falsify the subsequent precipitation with "magnesia mixture."

The presence of ammonium acetate facilitates rather than prevents the precipitation of the calcium as oxalate. On rendering the filtrate from the oxalate of calcium precipitate alkaline with ammonia, a small additional precipitation of oxalate of calcium may occur. If the solution of the manure has been made with acid, and subsequent evaporation of the acid liquid to dryness has been neglected, the precipitate here formed may contain silica or fluoride of calcium. If the separation of the iron and aluminium has been omitted, citric acid must be added before making the solution alkaline with ammonia. Of course, if a precipitate is formed at this stage, from whatever cause, it must be separated before adding "magnesia mixture."

Direct Citric Acid Method.

In this method the iron, aluminium, and calcium are all retained in solution by means of citrate of ammonium, and no attempt is made to separate the calcium as oxalate, but the phosphate is at once precipitated from the ammoniacal solution by magnesia mixture. Although in the hands of several chemists of high repute this convenient method gives very good results, the sources of error are too numerous to be wholly disregarded. Titration of the precipitate with uranium appears preferable to direct weighing.

Precipitation with "Magnesia Mixture."

Repeated experiments having shown that the employment of sulphate of magnesium for the precipitation of ammonio-magnesium phosphate is attended with considerable tendency to error, the Committee is of opinion that it should be definitely abandoned in favour of the chloride.

The volume of "magnesia mixture" employed for the precipitation should only be in moderate excess of the amount necessary to completely precipitate the phosphate present.

The use of a large excess of the precipitant causes a more rapid separation of the double phosphate, but is attended

* *Zeitschrift*, x., 133.

with such a serious tendency to error that any advantage gained is more than counterbalanced. The precipitation should be conducted in the cold. The proportion of free ammonia in the liquid should be large.

If the above precautions are duly observed, and silica, fluorine, iron, and aluminium be previously removed, it will rarely be necessary to purify the precipitate by solution in acid and re-precipitation with ammonia. In re-precipitating, some "magnesia mixture" should be added, as its presence tends to reduce the solubility of the precipitate in the ammoniacal liquid.

In igniting the precipitate, the heat should be very gentle at first, and afterwards be raised as high as possible. If citric acid has been employed the ignited precipitate is often discoloured. This may be remedied by cautious treatment in the crucible with strong nitric acid, followed by re-ignition.

If the precipitate of ammonio-magnesium phosphate be titrated by standard solution of uranium instead of being weighed many of the above precautions are rendered superfluous.

Estimation by Uranium.

The removal of iron and aluminium by addition of an alkaline acetate in the cold, with determination of the phosphoric acid in the filtrate by means of a standard solution of uranium, is a method which, in the opinion of the Committee, deserves extended employment. The use of an acetate in a slightly acid solution brings the liquid into just the condition required for the use of the uranium process. The proportions of acetic acid and alkaline acetate employed and the volume of the solution should be approximately constant. The uranium nitrate should be standardised with an acetic acid solution of pure precipitated ammonio-magnesium phosphate or tricalcic phosphate, instead of with phosphate of sodium.

The titration should be *converse*, the solution of the phosphate being added to that of the uranium. The latter should be mixed with a constant proportion of acetic acid, and heated on a bath of boiling water. The indicator should be powdered potassium ferrocyanide on a white porcelain slab. Owing to the reversal of the usual process, the brown colour of the ferrocyanide of uranium becomes gradually fainter till the end of the titration.

Molybdic Acid Method.

Sonnenschein's process of precipitation with molybdic acid, with subsequent treatment with magnesia mixture and weighing as magnesium pyrophosphate, is probably the most uniformly accurate of all known processes for determining phosphoric acid. It appears always to be employed when great accuracy is desired, and some chemists use it habitually. In some respects, however, the process is not well fitted for general use, for the following reasons:—

A very large excess of molybdic acid, above that which is actually precipitated as "phospho-molybdate of ammonium," is required for the complete separation of the phosphoric acid of the solution. The reagent is somewhat expensive, and there is no simple process of recovering the molybdenum from the filtrate.

The yellow precipitate contains less than 4 per cent of anhydrous phosphoric acid, and thus becomes very bulky and unmanageable when the quantity of phosphoric acid present exceeds 0·1 or 0·2 of a gramme. This fact leads to the employment of very small quantities of the material, and, as the yellow precipitate has to be subsequently re-dissolved and precipitated with magnesia mixture in the ordinary way, the error liable to occur from the use of an usually small weight of the sample detracts greatly from the value of the method.

The above considerations, together with the loss of time and expense incident to the use of the process, prevent the Committee from recommending it for general adoption, though they are of opinion that in many instances it may be used with great advantage, and that in some cases it is simply invaluable.

Pisani has described a method of determining molybdic acid by reducing its acid solution with zinc, and titrating the brown liquid with standard permanganate.

J. Macagno has proposed to apply this process to the determination of phosphoric acid by first precipitating the latter with "molybdate solution," and then titrating the molybdic acid in the precipitate in the above manner.

The Committee has instituted some experiments on this process, but the results were very unsatisfactory.

Reduced Phosphates.

It is well known that the soluble phosphate of some superphosphates has a tendency to pass back into the insoluble condition. It is plausibly argued that the finely-divided insoluble phosphate thus produced is equal in manurial value to the soluble phosphate originating it, and therefore that in judging of the value of the manure the insoluble "reduced" phosphate should be stated separately, and regarded as of equal manurial value to the actual soluble phosphate.

The methods which have been employed for the determination of "reduced" phosphate are based on the ready solubility of such precipitated phosphate in certain liquids or on its easy decomposition by certain alkaline salts. For its solution citrate of ammonium has been employed, and for its decomposition with formation of a soluble phosphate oxalate of ammonium* or bicarbonate of sodium† is used.

A series of very suggestive experiments on Chesshire's bicarbonate of sodium and Sibson's oxalate of ammonium methods have been communicated to the Committee by Mr. M. J. Lansdell, and as they appear to show conclusively the valueless character of either of the above processes for determining "reduced" phosphates, the results are given in full. The samples were all passed through the same sieve, and the proportions employed were those recommended by the authors:—

	Sample contained (equal to $Ca_3P_2O_8$).	Dissolved (equal to $Ca_3P_2O_8$). By Sibson's method.	By Chesshire's method.
	Per cent.	Per cent.	Per cent.
Cambridge coprolite	56·07	8·32	2·23
Bone-ash	76·87	10·58	3·07
Navassa phosphate..	65·62	7·48	5·73
German phosphate..	60·74	8·04	2·09
Redonda phosphate (dried)	87·42	19·72	56·97
Redonda phosphate (lump)	86·58	19·10	64·65

By employing a solution of bicarbonate of twice the above strength, the Redonda phosphate gave equal to 84·3 of $Ca_3P_2O_8$ in solution.

Using a smaller quantity of the sample in the oxalate method, 47·76 per cent passed into solution.

It appears, therefore, that reduced phosphates are indicated by each process even in natural phosphatic materials which have never been treated with acid, and hence the methods of determination are useless.‡

The same objections apply to the citrate of ammonium method, especially with respect to the phosphate of aluminium, known as "Redonda phosphate." It follows, therefore, that the latter comparatively cheap material would (if introduced into a superphosphate) be mistaken for and quoted as "reduced phosphate."

From the above considerations it appears that any known method of determining the reduced phosphates is purely arbitrary.

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* Chemical News, September 1869, p. 123.

† *Ibid.*, September 3, 1862, p. 111: Church's "Laboratory Guide," 3rd edition, p. 146.

‡ Mr. John Hughes has made experiments leading to a similar conclusion. Chemical News, xix., 229, and xx., 111.

It is now generally admitted that the cause of the "going back" to the condition of insoluble phosphate is the presence of iron or aluminium in the manure, and many chemists are of opinion that the "reduced" phosphates actually consist of the phosphates of iron and aluminium, produced by some such reaction as the following:—

$$CaH_4(PO_4)_2 + Al_2(SO_4)_3 = 2AlPO_4 + CaSO_4 + 2H_2SO_4.$$

At any rate, it is a fact that only manures containing iron and aluminium have a tendency to form reduced phosphates, so that the manufacturer has the remedy in his own hands—to avoid using mineral phosphate containing iron or aluminium.

In the analysis of mineral phosphates the proportion of oxide of iron and alumina is usually stated, but these constituents rarely appear in the analyses of "superphosphates" made therefrom.

It is generally held that the phosphates of iron and aluminium have a very limited manurial value, and this fact is a strong argument against the reduced phosphates being calculated into and credited as phosphate of calcium. The value of a manure so largely depends on the proportion of oxide and alumina present that the Committee is very strongly of opinion that the united percentage of these two bases in a manufactured manure (superphosphate) should always be stated. By doing so, the manufacturer or purchaser would be enabled to judge of the probability of a newly-made manure "going back" on keeping, and he would be in a better position to form an opinion of the true value of the sample. At the same time, the estimation of the "reduced" phosphates would often be rendered superfluous.

The actual mode of occurrence of some of the constituents of manures is very uncertain, and although interesting in a strictly scientific sense, is of very limited practical importance.

Statement of the Results of Analyses of Commercial Phosphates.

With respect to the mode of statement of the results of analyses of manufactured phosphates the Committee holds the following opinions.

When found in quantities greater than traces, the proportions of oxide of iron and alumina in the sample should always be stated, and also their equivalents of the corresponding phosphates ($FePO_4$ and $AlPO_4$) and the equivalent of the latter in tricalcic phosphate. Hence that item of the analysis would appear somewhat as follows:—

	Per cent.
Oxide of iron and alumina	A.
(Equal to phosphates of iron and aluminium	B p.c.)
(Equal to neutral phosphate of calcium	C p.c.)

If it be preferred for any reason to state the iron and aluminium as phosphates instead of oxides, the following form would be suitable:—

	Per cent.
Phosphates of iron and aluminium ..	B.
(Equal to neutral phosphate of calcium	C p.c.)
(Containing anhydrous phosphoric acid	D p.c.)

The object of stating the equivalents in phosphate of calcium and phosphoric acid is to give the manufacturer or purchaser an estimate of the tendency of the sample to "go back," owing to the formation of reduced phosphates.

The Committee is of opinion that the soluble phosphate in a manure prepared with acid is best stated as acid calcium phosphate, though in some cases it may be questioned whether it wholly exists in that form. The term "biphosphate" should as far as possible be abandoned, but as this cannot be done suddenly, it is recommended that the equivalent of $CaH_4(PO_4)_2$ in CaP_2O_6 should also be given. It is likewise desirable to state the equivalent amount of bone phosphate [$Ca_3(PO_4)_2$] from which the soluble phosphate has been derived. Hence the statement of the soluble phosphate will be somewhat as follows:—

	Per cent
Soluble acid phosphate of calcium ..	E.
(Equal to so-called "biphosphate of lime..	F p.c.)
(Equal to neutral phosphate of calcium (bone phosphate) made soluble.. ..	G p.c.)
(Containing anhydrous phosphoric acid	H p.c.)

The statement of the insoluble phosphate presents no difficulty.

The Committee is not prepared to make any recommendation respecting the statement of the calcium sulphate, but is of opinion that whether the anhydrous or hydrated substance is entered as existent in the sample, the equivalent of the other should also be added in parenthesis.

MENDING PLATINUM CRUCIBLES, &c.

By THOMAS GARSIDE, F.C.S.

Some months ago I had a platinum dish, which had a small hole on the side near the bottom, and the dish was consequently useless for most purposes. I was about to consign it to the old platinum, when it struck me that this metal being "weldable," I might manage to repair it. Having already a mould for this dish, made of plaster-of-Paris, and not of wood, this served admirably as an anvil. I then cut a piece of moderately thin platinum foil, about 3 m.m. diameter, and rubbed this and the part of the dish where the hole was with sea-sand until perfectly bright and clean. Having fixed the dish and its mould in an upright position, I laid the platinum foil over the hole, and directed the flame from a table blowpipe upon the spot. A pair of scissors served as a hammer, and by gently tapping with these, the two pieces of platinum united perfectly, and made so neat a joint that one would scarcely observe it unless one's attention was called to it. I have used the dish for all kinds of purposes since, but the union is as good as ever. In the above operation the plaster-of-Paris mould, although very dry, was split and cracked by the heat in all directions, nevertheless it had sufficient cohesion to last until the operation was concluded. I find that platinum wires are very easily joined in this way.

10, Cross-street, Southport.

MORPHIA REACTIONS.

By DAVID LINDO.

During the analysis of a complex mixture it was noticed that the aqueous solution exhibited an intense green colour. This solution was found to contain ammonia and copper salts with organic matter, which proved to be morphia. I have not seen this colour-reaction mentioned before, and as it might sometimes prove useful as a confirmatory test for morphia, I have endeavoured to ascertain the conditions most favourable to its development. These appear to be as follows:—

Dissolve 1 part crystallised sulphate of copper in 10 parts of water; add solution of ammonia cautiously and with active stirring until the precipitate is just dissolved.

To ascertain if this solution is fit for the intended purpose, dissolve 2 grains muriate morphia in 1 ounce of distilled water: place some of this in a test-tube, add a few drops of the test-fluid, and shake the vessel slightly. If a precipitate or permanent turbidity is observed, the test-fluid requires a little more ammonia, which should be added in small quantity at a time, and the mixture well

shaken after each addition, as a notable excess prevents the test from acting. Adding ammonia to the morphia mixture that is being tested to rectify deficiency in the test-fluid will not be found to answer.

When a few drops of a properly-prepared test-fluid are added to a neutral solution of morphia salt of the above strength, and the tube is slightly shaken, no cloudiness will be observed, but the fluid assumes a magnificent emerald-green colour either immediately or after a short time. Weaker solutions may require to be gently heated, but the mixture must not be boiled or the reaction is destroyed, suboxide of copper being precipitated.

Of a stronger solution of morphia salt one drop is sufficient to give a good reaction on a white porcelain surface. The test-fluid should be applied on a slender glass rod, and stirred in as soon as it is taken from the bottle.

If the copper solution has not been added in sufficient quantity the colour obtained will be yellowish green. Large excess of the reagent destroys the reaction, and so does the addition of a few drops of liquor ammonia.

Phenol is the only other colourless organic compound I have met with as yet which affords a similar colour-reaction with the test, but further experience on this point is desirable.

Falmouth, Jamaica, June 25, 1878.

ON THE ORIGIN OF ELEMENTARY SUBSTANCES, AND ON SOME NEW RELATIONS OF THE ATOMIC WEIGHTS.*

By HENRY WILDE.

The hypothesis that the solar system, as at present constituted, was formed by the successive condensations of a gaseous substance rotating under the influence of a central force, has so much evidence in its favour, that it may be affirmed to equal the best of that obtained from the geological record of the changes which, in past times, have taken place on the surface of the terrestrial globe. That this gaseous or primordial substance consisted of a chaotic mixture of the 65 elements known to chemists is a notion too absurd to be entertained by any one possessing the faculty of philosophic thinking, as the regular gradation of properties observable in certain groups of elements clearly shows that elementary species are not eternal, but have a history which it is the proper object of physical science to unfold.

One of the principal facts which to my mind establishes the nebular theory of the formation of planetary systems on a firm basis, is Bode's empirical law of the distances of the members of the solar system from each other, and from the central body, as in this law is comprehended the idea of nebular condensation in definite proportions. Now, if elementary species were created from a homogeneous substance, possessing a capacity for change in definite proportions, it is probable that the greater number of elements would be formed during, or after, the transition of the nebular matter from the annular to the spheroidal form. Moreover, as great cosmic transitions are not made *per saltum*, it might be expected that some modification of the law of nebular condensation into planetary systems, as exhibited in Bode's law, would be found on the further condensation of the primitive matter into elementary species.

The relations such as I have indicated exist between the nebular and elementary condensations, represented by the planetary distances on the one hand, with the atomic weights of well-defined groups of elementary substances on the other, will be evident on comparing the numbers in the following tables :—

I.

0 . 0 . 4 =	4 Mercury.
1 × 3 + 4 =	7 Venus.
2 × 3 + 4 =	10 Earth.
4 × 3 + 4 =	16 Mars.
8 × 3 + 4 =	28 Ceres, Pallas, &c.
16 × 3 + 4 =	52 Jupiter.
32 × 3 + 4 =	100 Saturn.
64 × 3 + 4 =	196 Uranus.

In the above table the numbers expressing the relative distances of the planetary bodies from the sun, and from each other, are obtained by multiplying successively the difference (3) between the distance of the first and second members of the system, by a geometric series, and adding to the products the constant distance (4) of the first member from the sun. Now, if the atomic weight of the second member of the alkaline and silver group of metals (Na = 23) be multiplied successively by an arithmetical series, then will the products, minus the atomic weight of the first member (Li = 7), be the atomic weight of all the elements belonging to that group.

II.

0 . 0 . 7 =	Li = 7
1 × 23 . 0 =	Na = 23
2 × 23 − 7 =	Ka = 39
3 × 23 − 7 =	Cu = 62
4 × 23 − 7 =	Rb = 85
5 × 23 − 7 =	Ag = 108
6 × 23 − 7 =	Cs = 131
7 × 23 − 7 =	— = 154
8 × 23 − 7 =	— = 177
9 × 23 − 7 =	Hg = 200

Again, by multiplying in like manner the atomic weight of the second member of the alkaline earth and cadmium groups of metals, the products, minus the atomic weight of the first member (Gl = 8), are the atomic weights of all the elements of this group.

III.

0 . 0 . 8 =	Gl = 8
1 × 24 . 0 =	Mg = 24
2 × 24 − 8 =	Ca = 40
3 × 24 − 8 =	Zn = 64
4 × 24 − 8 =	Sr = 88
5 × 24 − 8 =	Cd = 112
6 × 24 − 8 =	Ba = 136
7 × 24 − 8 =	— = 160
8 × 24 − 8 =	— = 184
9 × 24 − 8 =	Pb = 208

The further relations observable between interplanetary voids and atomic condensations of the natural groups of elements in tables II. and III. are as follows :—

1. The regular geometric series of the planetary distances commences at the second member of the system, and the regular arithmetical series of atomic weights commences at the second and corresponding member of each group.

2. As the atomic weight of the second element in each group is half the sum of the atomic weights of the first and third elements, so is the distance of the second member of the solar system an arithmetical mean, or half the sum of the distances of the first and third members.

3. The atomic weight of the fourth member in each group of elements is equal to the sum of the atomic weights of the second and the third; and the distance of the fourth member of the solar system is also equal, within a unit, to the sum of the distances of the second and third members.

4. As the smallest planetary distance is a constant function of the distances of the outer planetary bodies, so is the smallest atomic weight in each group a similar function of all the higher members of the series to which it belongs. It will also be observed that the plus and

* A Paper read before the Manchester Literary and Philosophical Society, April 30, 1878.

minus signs of these constants are correlated respectively with the interplanetary spaces and the elementary condensations.

5. Each of the atomic weights, after the third in the groups, is an arithmetical mean of any pair of atomic weights at the same distance above and below it; and the distance of each member of the solar system (minus the constant 4) is a mean proportional of the distances of any two members, externally and internally to it, from the central body.

6. The geometric ratio of the planetary distances from each other terminates at the two members nearest the central body, and approaches to an arithmetical one; and a similar departure is also noticeable from the regular arithmetical series of the atomic weights of the first two members of the groups, which renders the third less than an arithmetical mean of the atomic weights of the second and fourth members.

While most of the atomic weights in tables II. and III., excluding fractions, agree with those generally received by chemists, the remainder, except Cæsium = 133, do not vary more than a unit from the classical numbers. When it is considered that some of these numbers have been obtained by doubling the fractions of the old atomic weights, and that slight differences in the determinations may arise from the latent affinity which some elements have for minute quantities of another, the numbers in the tables are remarkably near to those determined by experiment—more so, in fact, than is Bode's law to the actual distances of the planets from the sun.

It will be observed that there are gaps to be occupied by two elements in the first group, with atomic weights 154 and 177, and by their homologues of position in the second group, with atomic weights 160 and 184, which remain to be discovered.

The numerical relations subsisting among the atomic weights in tables II. and III., and their resemblance to the homologous series in organic chemistry, afford further evidence in support of the theory that elementary species are formed by the successive condensations of a primordial substance of small specific gravity and low atomic weight. The physical and chemical properties of hydrogen, especially its low atomicity and its exact multiple relations with many elementary substances, long since suggested to Prout that this element might be the ponderable base of all the others.* Prout's hypothesis has not, however, made much progress, as chemical knowledge was not sufficiently advanced in his time to enable the intermediate steps to be perceived by which elements of high atomicity could be built up from hydrogen; and, besides this, the hypothesis afforded no explanation of the widely diverging properties of elements having nearly the same atomic weights. If, however, it be assumed that a particle of hydrogen combines successively with one, two, three, or more of its own particles, to form the molecules H_2, H_3, H_4, H_5, H_6, H_7, and that each of these molecules forms the type of a group of elements under it, the intermediate steps between the low atomic weight of hydrogen and the high atomic weights of other elements are perceived, and the different properties of elements of approximately equal atomic weights admit of a rational explanation.

Although it is herein assumed that hydrogen is the ponderable base of all elementary species, it is probable that this element itself, as further maintained by Prout, may have been evolved from an ethereal substance of much greater tenuity.† Further knowledge of the outer regions of the solar atmosphere, and of the zodiacal light, may possibly indicate the steps by which hydrogen was formed.

I would also observe that the term "molecule" is here used only in the sense of a larger or denser particle of matter, and does not imply the idea of a composite aggregation of the separate particles, each preserving its distinctive character after the molecule is formed, any more than rain drops preserve their distinctive character after falling into the ocean. It appears to me much more in accordance with the truth of nature to suppose that the smallest conceivable particle of a chemical substance or compound has the same physical properties absolutely as the mass. If it be objected that such a union of particles would have relations of infinity, as is therefore inconceivable, it may be answered that the central particles of a rotating body have mathematica and physical relations of a similar kind, and as the instrument of thought is incapable of forming a distinct conception of the magnitude of the infinitesimals involved in a centre of rotation, still less is it capable of comprehending the mode of union of the unknowable essences on which the physical qualities of chemical substances, after combination, depend. Philosophical chemists, I apprehend, will hereafter be able to refer the origin of the theory of the composite structure of matter, after chemical union, to the influence of ideas derived principally from the mechanical mixtures employed in pharmacy and in the culinary art.

In the present hypothesis it is assumed that a mass of hydrogen, of a curvilinear form, acquired a motion of rotation about a central point, which caused it to take a spiral or convoluted form. As each successive spiral or convolution was formed the particles of hydrogen combined with themselves as far as the septenary combination to constitute the type of each group of elements—the number of types or groups being equal to the number of convolutions of the rotating gas. According to this view, the elementary groups may be represented as forms of Hn, $H2n$, $H3n$, $H4n$, $H5n$, $H6n$, $H7n$; the internal convolutions forming the highest type $H7n$, and the outer convolution the type Hn. That on a further condensation of the elementary matter, a transition from the spiral to the annular form occurred, during, or after which, the group or species under each type was generated in concentric zones, and in the order of their atomic weights, until the highest member of each species was formed. That as the elementary vapours began to condense or assume the liquid form their regular stratification would be disturbed by eruptions of the imprisoned vapours from the interior of the rotating mass. This disturbance would be further augmented by the subsequent combination of the negative with the positive elements, and also by the variable solubility of their newly formed compounds; so that the evidence of such stratification of the elementary vapours as I have indicated, must necessarily be more fragmentary than that of the geological record. The constant association in nature, however, of several elements belonging to the same group, a remarkable example of which is the presence of lithium, potassium, rubidium, and cæsium in a single mineral, *lepidolite*, appears to confirm this view of the primitive arrangement of elementary vapours.

In the table at end are arranged all the known elements in natural groups, wherein gaps appear as in tables II. and III., which indicate the existence of missing elements. The atomic weights of other elements which have not been sufficiently investigated are also determined.

If the theory which I have enunciated of the evolution of elementary substances from hydrogen in definite proportions be correct, the numbers representing the atomic weights also represent the number of particles of hydrogen from which the elements were formed. Where these numbers do not coincide exactly, as in the case of Cu = 62, and its homologue of position, Zn = 64, which are each a unit less than the classical numbers, it is not to be supposed that these discrepancies are due to errors of experiment, but to some unknown cause which prevents their true atomicity from being ascertained.

Although the ideas of chemists on the classification and quantivalence of elements have greatly changed

* *Annals of Philosophy*, vol. vi., 330, 1815; vol. vii., 113, 1816.

† "Prout's Chemistry and Meteorology," 8th Bridgewater Treatise, p. 130.

during recent years, there is no question that the alkaline metals, lithium, sodium, potassium, rubidium, and cæsium, belong to the group which I have classified under H*n*. Chemists are also agreed that silver, notwithstanding the great divergence of some of its characteristics from those of the alkaline metals, also belongs to the same group. Now some of the physical and chemical properties of copper and mercury are more nearly allied to those of silver than to metals of other groups, and recent investigations have shown that silver may, like copper, be regarded as bivalent, since many of its compounds can be represented by formulæ exactly analogous to those of cuprous compounds with which they are isomorphous.* The position of Hg, Ag, and Cu, as alternate members of the series H*n*, indicate their relationship with sodium, and are thereby brought into still closer connection with Li, K, Rb, and Cs. That a relationship exists between sodium and silver, by the isomorphism of their anhydrous sulphates and in other ways, has already been pointed out by Odling. The greater specific gravity of sodium, while possessing a lower atomic weight than potassium, its passivity in the liquid state to the action of chlorine,† and its inferior volatility and oxidability to K, confirm the relationship of Na to the heavy metals of the series.

From what cause elements possessing physical properties so widely different should be associated alternately in regular order in the same series can only, in the present state of knowledge, be a subject of speculation; but, if the views which I have enunciated on the formation of the types H*n*—H7*n* be correct, it may be conceived that after the transition of the cosmical vapours from the spiral to the annular form, the gaseous material of each pair of members might rotate in concentric zones, separate from each other by an interval of space. It may be further conceived that the rotating zones of elementary matter were of sufficient thickness to cause a difference of density between their upper and lower regions. That the zones were in a highly electrical condition, and that their mutual influence on each other, through the annular space between them, would induce opposite electrical conditions in their external and internal regions; all the inner and denser regions of the zones being in a negative, and the outer or rarer regions in a positive electrical condition. Each zone would then be in a condition to form an electro-positive and an electro-negative element, which, on a subsequent condensation, would separate and form two zones of elements having dissimilar properties alternating with the other members of the same series.

Just as silver and sodium are the connecting links between Hg and Cu, and the alkaline metals Li, K, Rb, and Cs, so do cadmium and magnesium connect lead and zinc with the alkaline earth metals glucinum, calcium, strontium, and barium, which I have classified as forms of H2*n*. The classification of glucinum, with the alkaline earth metals has only recently been made, but chemists are not yet agreed upon the atomic weight of this element, as it has been fixed at Gl=7 (Awdejew) and Gl=9·4 (Reynolds). It may, however be suspected from the anomalously high specific gravity assigned to glucinum (2·10) as compared with that of magnesium (sp. gr. 1·74), and with their homologues of position, Li (sp. gr. 0·59) and Na (sp. gr. 0·97), that this element has not been isolated in a state of purity.‡ By assigning to glucinum the atomic weight Gl=8, it enters as a multiple into all the members of the series H2*n*, and may be regarded as the product of the first, second, or third powers of H2.

While the property of quantivalence would appear to be correlated with the number of hydrogen particles in the typical molecules from which the elements were evolved, and is a valuable aid in the classification of elementary species, this property in the present state of knowledge is not in many cases sufficient, of itself, to indicate the group to which an element belongs. This will be seen from the recognised bivalency of copper and mercury, and by the doubtful quantivalence of silver, and by analogy of sodium, all of which belong to the series H*n*. That tetratomic lead=208, is a member of the group H2*n*, is shown by the isomorphism of its oxide, carbonate, and sulphate, with the oxides, carbonates, and sulphates of barium, strontium, and calcium, besides which there is no other place vacant in the system of elements where one with the atomic weight and physical properties of lead would fit.

Were it not for the analogous physical properties, and the numerical relations subsisting among the elements grouped as forms of H3*n*, their classification from the property of quantivalence alone would have hardly been possible. There can, however, be little doubt that aluminium, yttrium, erbium, and thorium are rightly classified together, and that indium and thallium are true analogues of each other. As considerable interest attaches to this group at the present time, on account of the recent additions which have been made to it by the aid of spectral analysis, I here show the atomicities of its members in a separate table, calculated on the same principles as those in tables II. and III.

IV.

0 . 0 . 12 = C	= 12
1 × 27 . 0 = Al	= 27
2 × 27 − 12 = —	= 42
3 × 27 − 12 = —	= 69
4 × 27 − 12 = —	= 96
5 × 27 − 12 = Yt	= 123
6 × 27 − 12 = In	= 150
7 × 27 − 12 = E	= 177
8 × 27 − 12 = Tl	= 204
9 × 27 − 12 = Th	= 231

It will be observed that there are three elements missing in this group, the atomic weights of which can be predicted in like manner with those of the missing elements in the preceding groups. The table also affords the means of correcting and determining the atomicities of the series which, from their rarity, have not been sufficiently investigated. It will be further observed that, besides the similar numerical relations of the members of this group with those shown in tables II. and III., the atomic weights are all multiples of 3, and are classified accordingly as forms of H3*n*.

The spectral reactions of this series of elements are remarkable from the oxides of carbon and erbium giving a spectrum of lines at low temperatures, and by the simplicity of the spectral lines of indium and thallium in the more refrangible parts of the spectrum. The atomic weights of C, Al, Tl, and Th are identical with those generally received, and afford presumptive evidence that the atomic weights of the intermediate members are equally correct. It will, however, be observed that the atomic weights of yttrium and indium are double the accepted numbers (Y=61·7, In=75·6); but in regard to the latter element it has not yet been definitely agreed which multiple of 37·6, the original determination, shall be the classical one, as the atomicity has been fixed by different chemists at 75·6, 113, and 150, the number assigned to it in the table. The relations which the double atomic weights of In and Yt have to each other, and with their homologues of position, Cs, Ba, Ag, and Cd, in tables II. and III., render it highly probable that the atomic weights of Y and In in the table are correct. For similar reasons it is probable that the atomic weight of erbium will be found to be 177. It is only very recently that any investigations of the atomic weight of this rare element have been made, from the difficulty

* "Quantivalence of Silver,—Wislicenus, "Watts, Dic. Chem.," 2nd Suppl., 1088.

† "Watts, Dic. Chem.," Suppl., 1030.

‡ Since this paper was written, MM. Nilson and Petterson have communicated to the French Academy the results of their researches on the physical properties of glucinum, and have found for the metal a density equal to 1·64, which, although still too high, the theoretical density being about 1·3, is less than that of magnesium, and, consequently, stands in the same order of density as lithium and sodium.—*Comptes Rendus*, April 1st, 1877, p. 825.

attending its isolation from yttrium, with which it is found associated in nature. According to some chemists, the atomic weight of erbium is 112·6, which, in relation to 177, is nearly in the ratio of 5 to 8. The more recent researches of M. Cleve on the quantivalence of this element have, however, raised its atomic weight to 170·55* which, considering the wide difference between it and the previous determination, is a near approximation to the number in the table. The researches of the same chemist have also raised the atomic weight of yttrium from 61·7, the accepted determination, to 89·5, or three-fourths the calculated value. Now the history of chemical science abundantly shows that it is only after long and repeated investigation that the highest quantivalence of an element can be ascertained, and the result of M. Cleve's researches is a further confirmation of the correctness of the atomic weights of yttrium and erbium given in the table.

By comparing the electro-positive members of the series Hn with those of $H2n$, it will be seen that a complete parallelism exists between them; the light alkaline, and alkaline earth metals alternating with the heavy members in homologous positions in both series. Odling has already indicated that this is the natural order of the dissimilar members of the zinco-calcic group of elements,† and similar alternations in other natural groups have been recognized in the arrangement of elements proposed by Mr. Newlands‡ and Mendeleeff.‖

Just as Cu=62, Ag=108, and x=154, alternate with Rb=85, Cs=131, and x=177, in the series Hn; and Zn=64, Cd=112, and x=160, alternate with Sr=88, Ba=136, and x=184; so in the series $H3n$, do x=69, Yt=123, and Eb=177, alternate with x=96, In=150, and Tl=204. Again, just as K, Rb, Cs, and x=154, are analogues of each other in the series Hn, so are x=42, x=96, In, and Tl, analogues of each other in the series $H3n$, and are in homologous positions with the alkaline and alkaline earth metals in the series Hn and $H2n$. The specific gravities of analogous members of these two series, except glucinum, which is anomalous, increase in the order of their atomic weight, and so far as the specific gravities of the members of the series $H3n$ have been ascertained, they follow the same order. Now M. Lecoq de Boisbaudran has shown that the new metal which he has discovered, and named gallium,§ is, from its spectral reactions and other properties, the analogue of indium and thallium. The position of the new metal in the series $H3n$ should therefore be either − =42, homologous with Ca, and K, or − =96, homologous with Sr and Rb. In comparing the alkaline metals of the series Hn, the specific gravity of sodium (0·97), as will be seen, is greater than that of potassium (0·86), although Na has a less atomic weight; and the same inversion of specific gravities in relation to atomic weights is observable in their homologues of position Mg (sp. gr. 1·74), and Ca (sp. gr. 1·58), in the series $H2n$. It may therefore be assumed that the missing member x=42, $H3n$, would have a less specific gravity than Al (sp. gr. 2·56); probably 2·5. Now, the specific gravity of gallium, as determined by M. Lecoq de Boisbaudran, is 5·9,¶ and its analogues indium and thallium have specific gravities of 7·42, and 11·9 respectively, consequently x=42 is not gallium. If gallium were x=69 it would be the analogue of Y, E, and Th, and homologous in position with Zn and Cu, whereas it has been shown to be the analogue of In and Tl and homologous in position with Sr and Rb. There is then no other place for a metal having the physical properties of gallium but the one assigned to it in the series $H3n$, with the atomic weight=96, and forming a triad with indium and thallium. If, however, the experimental determination of the atomicity of gallium pass through the same stages as the atomicities of indium, yttrium, and other members of the series, its atomic weight will be represented by the sub-multiple and proportional numbers 48 and 72.*

(To be continued).

* *Bull. Société Chimique de Paris*, tome xxi., 344, 1874.
† "Watts, Dic. Chem.," 1865, vol. iii., 963—Classification of Metals.
‡ CHEM. NEWS, vol. xii., 83; vol. xiii., 113.
‖ Die periodische Gesetzmäfsigkeit der chemischen elemente—*Ann. Chem. Pharm.*, Suppl. Band, viii., 133—229, 1872; *Phil. Mag.*, 5th S, vol. i., 543.
§ *Comptes Rendus*, tome lxxxi., 403, 1000, 1865
¶ *Phil. Mag.* 5th S. vol. ii., 398.

* From a calcination of the gallo-ammoniacal alum, M. Lecoq de Boisbaudran has recently found for gallium the equivalent 70·03, and from a calcination of the nitrate, 69·6—(*Comptes Rendus*, April 15, 1878.) The researches of M. Berthelot on the specific heat of gallium indicate, however, a higher equivalent for the metal than 70·03, as the atomic heat calculated from this determination (5·52 solid) is lower than that of any other metal except silicium.—*Ibid.*, April 15th 1878.

NOTICES OF BOOKS.

Second Annual Report of the Inspector and Assayer of Liquors to the Commonwealth of Massachusetts. Boston: A. J. Wright.

IT appears that of the samples of liquors submitted to chemical examination about 33 per cent were either of very inferior quality and were more or less adulterated. The tabulated analytical report gives in connection with every sample the name of the vendor. A very large majority of the liquors examined were ardent spirits, very few samples of wines or malt-liquors having been taken. The adulterants discovered are neither novel nor interesting, consisting as a rule of water, with sugar, colouring-matters, and in one case methylic alcohol. The nine samples of beer and ale analysed were found free from cocculus indicus, strychnia, and picric acid, or "any other bitter except that of hops and malt." One sample of native American wine, "California claret," has been examined: it contains 9·2 per cent of alcohol and the solid residue, 11·4 per cent, consists merely of vegetable acids and astringents naturally derived from the grape. No magenta or other artificial colouring matter was present.

Guide to the Literature of the Dairy and of Cattle-keeping in General. ("Führer durch die Literatur über Milchwirthschaft und Molkereiwesen, Butter und Kaesefabrikation sowie Rindviehzucht überhaupt.") Leipzig: H. Voigt.

AN alphabetical catalogue of works on the above subjects.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 3, July 15, 1878.

Remarks Concerning the Influence of Atmospheric Electricity of Low Tension upon Vegetation.—M. Berthelot.—Referring to M. Grandeau's paper "On the Influence of Atmospheric Electricity upon the Nutrition of Plants" (*Comptes Rendus*, lxxxvii., No. 2), the author recalls the analogy of the result with his own experiments on the formation of nitrogenous matters under the influence of atmospheric electricity. Hitherto in agricultural chemistry there has been understood under the name of atmospheric electricity merely the formation of nitric and nitrous acids and their ammoniacal salts, produced by the passage of lightning, without having any idea of the direct reactions which may come into play between

plants and the atmosphere. Yet these latter seem to me the more important, the smallness of the effects being compensated by their duration and by the extent of the surfaces influenced.

Electro-metallurgy of Cobalt.—A. Gaiffe.—The author has been struck with the beauty of cobalt galvanically deposited as well as by its hardness. It is not oxidised like iron, and much less care is required to keep its surface in good condition. Its beautiful white colour will make it suitable for the decoration of other metals. The bath used was a neutral solution of the double sulphate of ammonia and cobalt, which does not require nearly so much care as the nickel baths. The anode may be a sheet of platinum, or better a plate of cobalt, either cast or forged. To obtain a white and adhesive deposit the current ought to be regulated at the outset, at 6 units of electro-motor force of the standard of the British Association, and be brought to 3 units only when the entire surface of the article to be coated has become white.

Reform of Certain Analytical Processes Employed in the Laboratories of Agricultural Stations and of Observatories of Chemical Meteorology. Volumetric Determination of the Sulphates in Waters.—A. Houzeau.—The process brought forward is simple and sufficiently precise. Qualities obtained by introducing into the volumetric method three new features:—(1.) The use of the "drop-counter" in place of the graduated burette. (2.) The evaluation of time in the accomplishment of the chemical reaction. (3.) The substitution of an empirical equivalent for the theoretic equivalent in the relation between the precipitant and the substance precipitated. One centilitre of water is poured into a test-tube 120 m.m. in length and 18 m.m. in diameter, and a drop of acetic acid is added. There are poured then by means of a "drop-counter" with a greased orifice (25 drops to 1 c.c.) 2, 4, 6, 8, or 10 drops of a standard solution of chloride of barium, containing per litre 30·5 grms. $BaCl_2HO$. After waiting 3 minutes, if a turbidity has been formed, the liquid is poured upon a single or double paper filter, previously moistened and drained, and of a capacity of about 12 c.c. The filtrate, which ought to be perfectly bright if the paper is of good quality, is received in a test-tube similar to the foregoing. One drop or more of the barytic solution is then poured in, and after the lapse of three minutes if a turbidity appears the liquid is thrown upon the same unwashed filter. The addition of the reagent is thus continued, and the filtration until the last drops of barium chloride no longer causes any cloudiness in the liquid in the space of three minutes. The advantage of the drop-counter is that it enables two or three determinations to be made simultaneously upon different samples of water with a single instrument. Two determinations of sulphate may thus be made in less than half an hour.

Specific Gravities of Solutions of Pure Sugar.—M. Barbet.—A table showing the theoretic and experimental weight per litre, with the increase of weight for every percentage of sugar from 1 to 90.

Bulletin de la Societe Chimique de Paris,
No. 12, June 20, 1878.

Synthesis of Cyan-acetyl-ureas and of Murexoin. E. Mulder.—The author obtains cyan-acetyl-urea on treating the chloride of cyan-acetyl with urea. It represents a derivative in which three atoms of carbon are successively united with a residue of urea, as is the case with barbituric acid. Cyan-acetyl-dimethyl-urea is produced by the action of the chloride of cyan-acetyl upon dimethyl-urea. If treated with a small quantity of nitric acid of sp. gr. 1·2 this urea gives rise to the formation of a compound of a fine purple-red colour, which is murexoin.

Russian Chemical Society. Session April 6/18, 1878.—M. Setschinoff announces, in order to take date, that in studying the action of carbonic acid upon albumen he finds that upon heating ordinary white of egg in a vacuum at 30° to 35° it gradually assumes a gelatinous texture, and is transformed into very hard fibrous flocks, having a great resemblance to the flocks of blood fibrin.

M. Beilstein, on his own behalf and on that of M. Kourbatoff, mentions that on causing ammonium sulphide to act upon symmetric dichloro-nitrobenzin, dichloranilin and dichlor-azoxybenzin are obtained.

M. Beilstein also described the result of the researches of M. Erémine on the preparation of ozone. The latter finds that an aqueous solution of oxalic acid absorbs a considerable quantity of ozone. This solution appears to be more stable in the light than in darkness. For coating the corks and joints needful in the preparation of ozone the author recommends the following mixtures:—For the corks a mixture of paraffin, wax, and rosin, and for the joints or lutes a mixture of glycerin and gelatin.

E. Wagner gave an account of M. Eltekoff's researches on the action of water and oxide of lead on the combinations of hydrocarbides of the series C_nH_{2n} with the halogens.

E. Wagner also described the investigations of M. Muller upon the nitrophthalic acids. The author gave a detailed description of the preparation, properties, and separation of the two nitrophthalic acids formed by the action of nitric upon phthalic acid. The new nitrophthalic acid, which the author names isonitrophthalic acid, melts at 160°, whilst the melting-point of the other is 204° to 206°.

M. Mendeleef on behalf of E. Schœne described the action of hydrogen peroxide upon the oxy compounds of thallium. Whether in solution or in the gaseous state it converts thallous oxide into a brown oxide insoluble in water. The brown colouration of ozonoscopic paper impregnated with thallium cannot, therefore, serve as proof of the presence of ozone in the atmosphere in which the author has previously demonstrated the presence of hydric peroxide.

M. Wreden announces that he has converted ordinary camphor into a liquid isomer by the action of dilute hydrochloric acid at 190°. The new compound boils at 187° to 193°. Its sp. gr. =0·913, and it does not crystallise at a temperature of −17°.

M. Rudneff made a preliminary communication on the trimethyl-carbinamin obtained by M. Boutlerow as a secondary product of the preparation of trimethyl-acetic acid.

M. Kaschirsky communicated the results of his researches on the action of zinc-methyl upon the bromanhydrides of the saturated mono-bromated fatty acids of the series α.

M. Menchoutkine announces that the researches on the etherification of the primary and secondary alcohols which he had previously communicated to the Society contains errors which will necessitate further experiments. It is to be remarked that at present the limit of the ethylacetic system, according to these new researches, coincides with that given by M. Berthelot.

Determination of Manganese in Irons, Cast-irons, and Steels; in Spiegel, Ferromanganese, and Ores.—M. Deshays.—When to a nitric or nitrosulphuric solution of manganese there is added a certain quantity of plumbic dinoxide there is immediately produced a violet-red colouration, varying in intensity and in tone according to the quantity of manganese contained in the acid liquor. In all cases the colouration is so much the stronger as the quantity of manganese is more considerable, but it is still perceptible, even in case of extremely minute quantities. The tone varies according as the liquid contains nitric acid alone or a mixture of nitric and sulphuric, according to the degree of oxidation of the manganese, and also according to its origin. Thus, when employing the plumbic acid reaction for the qualitative detection of manganese in cast-irons and ores, we may have tones varying from the red of an onion skin to a

deep violet. To obtain comparable tints it is essentially necessary to operate under the same conditions, and to measure exactly the quantities of acid and of peroxide employed. In spite of these precautions, in the case of ores, the tone of the colouration seems to vary with the state of oxidation of the manganese. This reaction has been applied by M. Leclerc for the determination of manganese in soils and ashes, and subsequently M. Boussingault has used it for irons and steels. These two *savants* employed a standard solution of mercurous nitrate, which, if poured into the violet liquor containing the manganese, reduces the permanganic acid and decolourises the liquor. Up to 0·300 per cent of manganese the quantity of the reducing liquid employed to produce this decolouration appears proportional to the percentage of manganese; above this it is no longer proportional. The author has sought to utilise this method, but unsuccessfully, the majority of the steels now manufactured by the Bessemer and Martin processes containing more than 0·500 per cent of manganese. On the other hand, in case of cast-irons and ores, he has merely obtained irregular and conflicting results. On substituting for the mercurous nitrate a solution of arsenious acid analogous to that employed in chlorimetry the results appeared better, and the author has thought the method applicable for determining tolerably high proportions of manganese. As the hydrochloric solution of arsenious acid is difficult to prepare and often forms a deposit in the bottles he has finally adopted the arsenite of soda.

Fermentation of Beer.—P. Muller.—An account of the vegetable growths which modify alcoholic fermentation.

Chemiker Zeitung.
No. 27.

In this issue is an interesting account of the manufacture of a fine quality of lamp-black,—so-called diamond black—by the combustion of the natural gas issuing from two wells at Gambier, in Ohio. The yearly production is about 16 tons, and the quality is excellent.

The "Germanic Museum" at Nürnberg has been recently enriched with a number of mathematical and physical instruments and apparatus.

Amber is found in Roumania. It differs in colour from that obtained on the coasts of the Baltic, being occasionally rose, red, brown, blue, green, and black. Specimens are occasionally found containing veins and spots resembling silver and gold in colour. In chemical composition and probable origin the Roumanian amber does not differ from the Prussian.

A rich deposit of coal has been discovered at Chala Alta, near Olazco, in Peru. The quantity is calculated as sufficient for the entire wants of South America for a long time.

Tartar in Wines.—Dr. M. Büchner. — The author finds that, on submitting wine to a low temperature, almost half the tartar present is deposited, and is not redissolved on a subsequent rise of temperature. A low percentage of tartar is no proof that water has been added. The percentage of tartar bears no direct proportion to the percentage of ash.—(*Dingler's Polytech. Journal.*)

Metallic tungsten, chemically pure, is now manufactured in Hanover at a very low price.

No. 28.

Chemical Industry at the Paris Exhibition.—Dr. C. Deite.—The author here treats of petroleum, mineral wax, or ceresin, bees'-wax, and turpentine. He considers that the Russian mineral oil from the wells of the Caucasus will never be able to compete with the American, both on account of the difficulty of transport and of the inferior quality. The Gallician petroleum may, in course of time, prove a formidable rival to the American. Ceresin is prepared from ozokerit, and is chiefly manufactured in Austria. The total yield of ozokerit in Gallicia, in 1875, amounted to 20 million kilos. Italy takes the first rank in the utilisation of bees'-wax, the yearly production of the kingdom being estimated at from 6 to 7 million kilos. The wax bleached in Venice is considered the best, and its excellence is ascribed to the fact of its immunity from the dust of the main land.

The Condition of the Public Laboratories of France. — An important and interesting paper. The author maintains that, as far as the applications of chemistry to the arts and manufactures are concerned, France can only claim the third rank.

Tropæolin as an Alkalimetric Indicator.—The reaction is said to be far from sufficiently distinct for use in volumetric analysis.

No. 29.

This issue contains an account of the oil and fat manufacture as represented at the Paris Exhibition.

Process for the Detection of Alcohol in Ethereal Oils.—A Drechsler.—The author uses a solution of 1 part potassium bichromate in 10 parts of nitric acid of spec. grav. 1·30. This new reagent shows the presence even of the smallest traces of alcohol in ethereal oils, as on its addition there is evolved, along with the specific odour of the oil, the well-known pungent smell of nitrite of ethyl-oxide, whilst, at the same time, a very characteristic change of colour occurs, which is very different, according to the quality of the different ethereal oils, and is best observed by using for the experiment small porcelain capsules shaped like a watch-glass. Five to six drops of the oil in question are poured into a capsule, 2 or 3 drops of the reagent are added, and the whole is let stand. In certain oils a remarkably beautiful play of colour appears in the mixture.

Lustre and Colour of Potassium.—Dr. Erckmann.—As a lecture experiment, the author introduces a piece of potassium, of the size of a pea, into a small test-tube, heats to fusion, turns the glass round and round till the metal congeals, and then seals up the tube. The greater part of the potassium is deposited on the sides of the tube as a specular metallic coating, resembling silver, and can be exhibited during lectures, &c. The other alkaline metals may be similarly treated.

It is reported from Munich that a case of arsenical poisoning has occurred in a man who has been suffering from a disease of the eyes, and who has for a long time worn a green silk screen over his face.

Biedermann's Central-blatt,
Heft 2.

Water-Examination and Water-Pollution.—Dr. H. Vohl, Dr. F. Fischer, and J. P. Dahlem.—Dr. Vohl has examined the waters of the Rhine, between Cologne and Mühlheim, with particular reference to the putrid matters introduced by cesspools, privies, domestic and industrial residues. As the material for his investigations, he selected the incrustations and residual waters from the boilers of steam-boats, which ply upon certain parts of the river only, choosing those only where no compositions are used to prevent deposits. In the incrustations, the presence of arsenic was distinctly recognised, derived doubtless from the waste waters of dye and colour-works. The tests applied for other poisonous metallic oxides, such as copper, lead, and zinc, gave negative results. A not inconsiderable amount of phosphoric acid owes its presence, according to Dr. Vohl, to the influx of excrementitious liquids. The existence of fatty acids in the concretions proves the contamination of the water with soap-lyes. In the concentrated residual waters were found considerable quantities of chlorine and nitrites, a proof that the river receives large quantities of animal refuse. The presence of sulphuretted hydrogen indicates,

with great probability, the presence of sulphites and hyposulphites, whose origin is still dubious. Dahlem rejects all the methods hitherto in use for testing the purity of drinking water, such as Fleck's silver-solution, permanganate, microscopic examination, &c., and declares that all depends here on the reply to the chemico-biological question :—"Is the organic matter present in water of such a kind that it can serve as nutriment for the low organisms belonging to the family of moulds?" As these organisms have the property of flourishing better upon congealed albuminoids than upon such as are still in solution, and can do this upon materials coated or saturated with such compounds, the author selected for his experiments in this direction the production of films by means of a solution of tannin at 5 per cent. Of this, he pours 5 c.c. into 100 c.c. of the water under examination, and finds that in all waters where a turbiditya rose, whether sooner or later, mould appeared, forming a thick crust, whilst in the opposite case, under perfectly similar circumstances—a temperature of 12° to 15° (C. or R.?)—no mould appeared even on standing for weeks.

Studies on Soil.—Eugen Risler.—An examination of the soils of the Canton Valais, of the "mollasse" occupying the territory between the Alps and the Jura, and of the glacier diluvium of the cantons Valais and Geneva.

The Activity of the Earth-worm in the Fertility of the Soil.—V. Hensen.—The author maintains that soils considered barren are made fit for vegetation by the two-fold activity of the worms, which open passages for the roots and line these passages with humus. In sandy soils the burrows of the earth-worm extend almost vertically to a depth of 3, 4, or even 6 feet, and are sometimes carried horizontally at the bottom. These passages are coated inwardly with the black excrements of the worm. Old worm burrows are occupied by the roots of the plants growing on the surface, which send out capillary rootlets to the walls of the burrow. The question whether all the roots of plants found growing in the subsoil have originally penetrated down worm-burrows cannot be decided with certainty. A microscopic examination of the masses deposited by earth-worms shows that they resemble the well-rotted leaf-mould used by gardeners in potting plants; most of the vegetable cells are destroyed through single cells, and fragments of tissues remain, mixed with many sand-granules. The statement that the earth-worm gnaws the roots of plants is, according to the author, totally unsupported by facts. The intestines of the worm never contain parts of recent plants.

On High Percentages of Nitrogen in Peaty Soils, and in Humiferous Marls, and on the Signification of Certain Humates Concerning the Absorption of Ammonia.—Prof. H. Ritthausen.—The author has repeatedly found in peat, peat soils, and humiferous marls, quantities of nitrogen higher than occur in ordinary soils. In consequence of similar observations, peat has been recommended as a manure. In a sample of peat dried at 100°, the author found 3·22 per cent of nitrogen. It appears that humus and similar bodies retain ammonia energetically, forming sparingly soluble nitrogenous bodies, which partly consist of ammonia-humates of lime and magnesia.

Researches on Seeds from High Latitudes.—Prof. A. Petermann.—The author concludes that the seeds of Timothy grass, clover, pine and fir, gathered in Sweden, between latitudes 55·20° and 60·40°, are distinguished from those grown in more southern lands by their higher germinating power, which is shown not merely by the large number of fruitful seeds, but also by the energy of the process of germination; by their cleanness, and by their great average absolute weight. These results are in accordance with the principle of natural selection.

Influence of Gypsum in Water used for Brewing.—L. Geisler, C. Frank, and O. Schottler.—The yield of extract from the malt is considerably diminished by the presence of gypsum in the water, though amount of proteinoids in the wurt is not affected. The proportion of phosphoric acid in the wort is reduced by nearly half, and the ash undergoes no increase proportionate to the quantity of gypsum.

Heft 3.

Presence of Hydrogen Peroxide in the Atmosphere.—Sergius Kern.—The author found Houzeau's view—that the amount of hydric peroxide in the air is influenced by the locality—confirmed in so far that he could detect a difference between the respective proportions present in the rain of St. Petersburg and of Moscow.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JULY, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Anhydride. Sulphuric	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Slightly turbid	0·001	0·010	0·125	0·068	19·20	5·970	0·648	0·94	1·130	13·7	3·00
West Middlesex	Slightly turbid	0·001	0·010	0·090	0·067	18·50	5·580	0·612	1·01	1·200	14·3	3·60
Southwark and Vauxhall	Clear	0·001	0·011	0·090	0·067	17·60	5·420	0·648	1·01	1·230	13·7	3·00
Chelsea	Clear	0·001	0·009	0·075	0·057	18·30	5·120	0·684	0·94	1·370	13·2	3·30
Lambeth	Clear	0·001	0·009	0·105	0·068	18·70	5·750	0·720	1·01	1·470	13·2	3·30
Other Companies.												
Kent	Clear	0·000	0·002	0·390	0·010	29·80	8·340	0·684	1·72	3·730	20·6	6·50
New River	Clear	0·000	0·008	0·135	0·046	18·30	5·580	0·648	0·94	0 930	13·2	3·30
East London	Clear	0·000	0·008	0·090	0·046	19·90	6·200	0·828	1·16	1·400	13·7	3·00

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B

THE CHEMICAL NEWS.

Vol. XXXVIII. No. 977.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Dublin Meeting, August 14, 1878.

INAUGURAL ADDRESS OF THE PRESIDENT,

William Spottiswoode, M.A., D.C.L., LL.D., F.R.S., F.R.A.S., F.R.G.S.

On looking back at the long array of distinguished men who both in this and in the sister countries have filled the chair of the British Association; on considering also the increased pains which have been bestowed upon, and the increased importance attaching to, the Presidential Address; it may well happen when, as on this occasion, your choice has fallen upon one outside the sphere of professional Science, that your nominee should feel unusual diffidence in accepting the post. Two considerations have, however, in my own case outweighed all reasons for hesitation: First, the uniform kindness which I received at the hands of the Association throughout the eight years during which I had the honour of holding another office; and, secondly, the conviction that the same goodwill which was accorded to your Treasurer would be extended to your President.

These considerations have led me to arrange my observations under two heads, viz., I propose first to offer some remarks upon the purposes and prospects of the Association with which, through your suffrages, I have been so long and so agreeably connected; and, secondly, to indulge in a few reflections, not indeed upon the details or technical progress, but upon the external aspects and tendencies of the Science which on this occasion I have the honour to represent. The former of these subjects is perhaps trite; but as an old man is allowed to become garrulous on his own hobby, so an old officer may be pardoned for lingering about a favourite theme. And, although the latter may appear somewhat unpromising, I have decided to make it one of the topics of my discourse, from the consideration that the holder of this office will generally do better by giving utterance to what has already become part of his own thought, than by gathering matter outside of its habitual range for the special occasion. For, as it seems to me, the interest (if any) of an address consists, not so much in the multitude of things therein brought forward, as in the individuality of the mode in which they are treated.

The British Association has already entered its fifth decade. It has held its meetings, this the 48th, in twenty-eight different towns. In six cities of note, viz., York, Bristol, Newcastle-on-Tyne, Plymouth, Manchester, and Belfast, its curve of progress may be said to have a node, or point through which it has twice passed; in the five Universities of Oxford, Cambridge, Dublin, Edinburgh, and Glasgow, and in the two great commercial centres, Liverpool and Birmingham, it may similarly be said to have a triple point, or one through which it has three times passed. Of our forty-six Presidents more than half (twenty-six, in fact) have passed away; while the remainder hold important posts in Science, and in the Public Service, or in other avocations not less honourable in themselves, nor less useful to the commonwealth. And whether it be due to the salubrity of the climate or to the calm and dispassionate spirit in which Science is pursued by its votaries here, I do not pretend to say; but it is a fact that the earliest of our ex-Presidents still living, himself one of the original members of the Association, is a native of and resident in this country.

At both of our former meetings held in Dublin, in 1835 and 1857 respectively, while greatly indebted to the liberal hospitality of the citizens at large, we were, as we now are, under special obligations to the authorities of Trinity College for placing at our disposal buildings, not only unusually spacious and convenient in themselves, but full of reminiscences calculated to awake the scientific sympathies of all who may be gathered in them. At both of those former Dublin meetings the venerable name of Lloyd figured at our head; and if long-established custom had not seemed to preclude it, I could on many accounts have wished that we had met for a third time under the same name. And although other distinguished men, such as Dr. Robinson, Professors Stokes, Tyndall, and Andrews, are similarly disqualified by having already passed the Presidential chair, while others again, such as Sir W. R. Hamilton, Dr. M'Cullagh, and Professor Jukes, are permanently lost to our ranks, still we should not have had far to seek, had we looked for a President in this fertile island itself. But as everyone connected with the place of meeting partakes of the character of host towards ourselves as guests, it has been thought by our oldest and most experienced members that we should better respond to an invitation by bringing with us a President to speak as our representative than by seeking one on the spot; and we may always hope on subsequent occasions that some of our present hosts may respond to a similar call.

But leaving our past history, which will form a theme more appropriate to our jubilee meeting in 1881, at the ancient city of York, I will ask your attention to a few particulars of our actual operations.

Time was when the Royal Societies of London and Edinburgh and the Royal Irish Academy were the only representative bodies of British Science and the only receptacles of memoirs relating thereto. But latterly the division of labour, so general in industrial life, has operated in giving rise to special Societies, such as the Astronomical, the Linnæan, the Chemical, the Geological, the Geographical, the Statistical, the Mathematical, the Physical, and many others. To both the earlier or more general, and the later or more special societies alike, the British Association shows resemblance and affinity. We are general in our comprehensiveness; we are special in our sectional arrangement; and in this respect we offer not only a counterpart, but to some extent a counterpoise, to the general tendency to subdivision in Science. Further, still, while maintaining in their integrity all the elements of a strictly scientific body, we also include, in our character of a microcosm, and under our more social aspect, a certain freedom of treatment, and interaction of our various branches, which is scarcely possible among separate and independent societies.

The general business of our meetings consists, first, in receiving and discussing communications upon scientific subjects at the various sections into which our body is divided, with discussions thereon; secondly, in distributing, under the advice of our Committee of Recommendations, the funds arising from the subscriptions of members and associates; and, thirdly, in electing a Council upon whom devolves the conduct of our affairs until the next meeting.

The communications to the sections are of two kinds, viz., papers from individuals, and reports from Committees.

As to the subject-matter of the papers, nothing which falls within the range of Natural Knowledge, as partitioned among our sections, can be considered foreign to the purposes of the Association; and even many applications of Science, when viewed in reference to their scientific basis, may properly find a place in our proceedings.

So numerous, however, are the topics herein comprised, so easy the transition beyond these limits, that it has been thought necessary to confine ourselves strictly within this range, lest the introduction of other matters, however interesting to individual members, should lead to the sacrifice of more important subjects. As to the form of the communications, while it is quite true that every scientific conclusion should be based upon substantial evidence, every theory complete before being submitted for final adoption, it is not the less desirable that even tentative conclusions and hypothetical principles when supported by sufficient *primâ facie* evidence, and enunciated in such a manner as to be clearly apprehended, should find room for discussion at our sectional meetings. Considering, however, our limitations of time, and the varied nature of our audience, it would seem not inappropriate to suspend, mentally if not materially, over the doors of our section rooms, the Frenchman's dictum, that no scientific theory "can be considered complete until it is so clear that it can be explained to the first man you meet in the street."

Among the communications to the Sections, undoubtedly the most important, as a rule, are the Reports; that is to say, documents issuing from specially appointed committees, some of which have been recipients of the grants mentioned above. These Reports are in the main of two kinds. First, accounts of observations carried on for a series of years, and intended as records of information on the special subjects; such, for instance, have been those made by the Kew Committee, by the committees on Luminous Meteors, on British Rainfall, on the Speed of Steamships, on Underground Temperature, on the Exploration of certain Geological Caverns, &c. These investigations, frequently originating in the energy and special qualifications of an individual, but conducted under the control of a Committee, have in many cases been continued from year to year, until either the object has been fully attained, or the matter has passed into the hands of other bodies, which have thus been led to recognise an inquiry into these subjects as part and parcel of their appropriate functions. The second class is one which is perhaps even more peculiar to the Association; viz., the Reports on the progress and present state of some main topics of Science. Among these may be instanced the early Reports on Astronomy, on Optics, on the Progress of Analysis; and later, those on Electrical Resistance, and on Tides; that of Professor G. G. Stokes on Double Refraction; that of Professor H. J. Smith, on the Theory of Numbers; that of Mr. Russell, on Hyperelliptic Transcendents, and others. On this head Professor Carey Foster, in his address to the Mathematical and Physical Section at our meeting last year, made some excellent recommendations, to which, however, I need not at present more particularly refer, as the result of them will be duly laid before the section in the form of the report from a Committee to whom they were referred. It will be sufficient here to add that the wide extension of the Sciences in almost every branch, and the consequent specialisation of the studies of each individual, have rendered the need for such reports more than ever pressing; and if the course of true Science should still run smooth it is probable that the need will increase rather than diminish.

If time and space had permitted, I should have further particularised the Committees, occasionally appointed, on subjects connected with education. But I must leave this theme for some future President, and content myself with pointing out that the British Association alone among scientific societies concerns itself directly with these questions, and is open to appeals for counsel and support from the great teaching body of the country.

One of the principal methods by which this Association materially promotes the advancement of Science, and consequently one of its most important functions, consists in grants of money from its own income in aid of special scientific researches. The total amount so laid out during the forty-seven years of our existence has been no less than £44,000; and the average during the last ten years has been £1450 per annum. These sums have not only been in the main wisely voted and usefully expended; but they have been themselves productive of much additional voluntary expenditure of both time and money on the part of those to whom the grants have been entrusted. The results have come back to the Association in the form of papers and reports, many of which have been printed in our volumes. By this appropriation of a large portion of its funds, the Association has to some extent anticipated, nay, even it may have partly inspired the ideas, now so much discussed, of the Endowment of Research. And whether the aspirations of those who advocate such endowment be ever fully realised or not, there can, I think, be no doubt whatever that the Association in the matter of these grants has afforded a most powerful stimulus to original research and discovery.

Regarded from another point of view these grants, together with others to be hereafter mentioned, present a strong similarity to that useful institution, the Professoriate Extraordinary of Germany, to which there are no foundations exactly corresponding in this country. For, beside their more direct educational purpose, these Professorships are intended, like our own grants, to afford to special individuals an opportunity of following out the special work for which they have previously proved themselves competent. And in this respect the British Association may be regarded as supplying, to the extent of its means, an elasticity which is wanting in our own Universities.

Besides the funds which through your support are at the disposal of the British Association, there are, as is well known to many here present, other funds of more or less similar character, at the disposal or subject to the recommendations of the Royal Society. There is the Donation Fund, the property of the Society; the Government Grant of £1000 per annum, administered by the Society; and the Government Fund of £4000 per annum (an experiment for five years) to be distributed by the Science and Art Department, both for research itself and for the support of those engaged thereon, according to the recommendations of a Committee consisting mainly of Fellows of the Royal Society. To these might be added other funds in the hands of different Scientific Societies.

But although it must be admitted that the purposes of these various funds are not to be distinguished by any very simple line of demarcation, and that they may therefore occasionally appear to overlap one another, it may still, I think, be fairly maintained that this fact does not furnish any sufficient reason against their co-existence. There are many topics of research too minute in their range, too tentative in their present condition, to come fairly within the scope of the funds administered by the Royal Society. There are others, ample enough in their extent, and long enough in their necessary duration, to claim for their support a national grant, but which need to be actually set on foot or tried before they can fairly expect the recognition either of the public or of the Government. To these categories others might be added, but the above-mentioned instances will perhaps suffice to show that even if larger and more permanent funds were devoted to the promotion of research than is the case at present, there would still be a field of activity open to the British Association as well as to other scientific bodies which may have funds at their disposal.

On the general question it is not difficult to offer strong arguments in favour of permanent national Scientific Institutions; nor is it difficult to picture to the mind an ideal future when Science and Art shall walk hand in hand together, led by a willing minister into the green pastures of the Endowment of Research.* But while

* It is worth while to compare the following passage from Plato's "Republic," Book vii. (Jowett's translation):

"After plane geometry, we took solids in revolution instead of

allowing this to be no impossible a future, we must still admit that there are other and less promising possibilities, which under existing circumstances cannot be altogether left out of our calculations. I am therefore on the whole inclined to think that, while not losing sight of larger schemes, the wisest policy, for the present at all events, and pending the experiment of the Government Fund, will be to confine our efforts to a careful selection of definite persons to carry out definite pieces of work; leaving to them the honour (or the onus if they so think it) of justifying from time to time a continuation of the confidence which the Government or other supporting body may have once placed in them.

Passing from the proceedings to other features and functions of our body, it should be remembered that the continued existence of the Association must depend largely upon the support which it receives from its members and associates. Stinted in the funds so arising, its scientific effectiveness would be materially impaired; and deprived of them, its existence would be precarious. The amount at our disposal in each year will naturally vary with the population, with the accessibility, and with other circumstances of the place of meeting; there will be financially, as well as scientifically, good years and bad years. But we have in our invested capital a sum sufficient to tide over all probable fluctuations, and even to carry us efficiently through several years of financial famine, if ever such should occur. This seems to me sufficient; and we have therefore, I think, no need to increase our reserve, beyond perhaps the moderate addition which a prudent treasurer will always try to secure against expenditure which often increases and rarely diminishes.

But however important this material support may be to our existence and well being, it is by no means all that is required. There is another factor which enters into the product, namely, the personal scientific support of our best men. It is, I think, not too much to say, that without their presence our meetings would fail in their chief and most important element, and had best be discontinued altogether. We make, it must be admitted, a demand of sensible magnitude in calling upon men who have been actively engaged during a great portion of the year, at a season when they may fairly look for relaxation, to attend a busy meeting, and to contribute to its proceedings; but unless a fair quota at least of our veterans, and a good muster of our younger men, put in their appearance, our gatherings will be to little purpose. There was a period within my own recollection when it was uncertain whether the then younger members of our scientific growth would cast in their lot with us or not, and when the fate of the Association depended very much upon their decision. They decided in our favour; they have since become Presidents, Lecturers, and other functionaries of our body; with what result it is for you to judge.

Of the advantages which may possibly accrue to the locality in which our meetings are held, it is not for us to speak; but it is always a ground for sincere satisfaction to learn that our presence has been of any use in stimulating an interest, or in promoting local efforts, in the direction of Science.

The functions of the British Association do not, however, terminate with the meeting itself. Beside the special committees already mentioned, there remains a very important body, elected by the General Committee, viz., the Council, which assembles at the office in London from time to time as occasion requires. To this body belongs the duty of proposing a President, of preparing for the approval of the General Committee the list of Vice-Presidents and sectional officers, the selection of evening lecturers, and other arrangements for the coming meeting.

At the present time another class of questions occupies a good deal of the attention of the Council. In the first generation of the Association, and during the period of unwritten, but not yet traditional, law, questions relating to our own organisation or procedure either "settled themselves," or were wisely left to the discretionary powers of those who had taken part in our proceedings during the early years of our existence. These and other kindred subjects now require more careful formularisation and more deliberate sanction. And it is on the shoulders of the Council that the weight of these matters in general falls. These facts deserve especial mention on the present occasion, because one part of our business at the close of this meeting will be to bid farewell officially to one who has served us as Assistant Secretary so long and so assiduously that he has latterly become our main repertory of information, and our mentor upon questions of precedent and procedure. The post hitherto held by Mr. Griffith (for it is to him that I allude) will doubtless be well filled by the able and energetic member who has been nominated in his place; but I doubt not that even he will be glad for some time to come to draw largely upon the knowledge and experience of his predecessor.

But, beside matters of internal arrangement and organisation, the duties of the Council compromise a variety of scientific subjects referred to them by the General Committee, at the instance of the Committee of Recommendations, for deliberation and occasionally for action. With the increasing activity of our body in general, and more particularly with that of our various officers, these duties have of late years become more varied and onerous than formerly; nor is it to be wished that they should diminish in either variety or extent.

Once more, questions beyond our own constitution, and even beyond the scope of our own immediate action, such as education, legislation affecting either the promotion or the applications of science to industrial and social life, which have suggested themselves at our meetings, and received the preliminary sanction of our Committee of Recommendations, are frequently referred to our Council. These, and others which it is unnecessary to particularise, whether discussed in full Council or in committees specially appointed by that body, render the duties of our councillors as onerous as they are important.

While the Government has at all times, but in a more marked manner of late years, recognised the Royal Society of London, with representatives from the sister societies of Dublin and of Edinburgh, as the body to which it should look for counsel and advice upon scientific questions, it has still never shown itself indisposed to receive and entertain any well-considered recommendation from the British Association. Two special causes have in all probability contributed largely to this result. First, the variety of elements comprised by the Association, on account of which its recommendations imply a more general concurrence of scientific opinion than those of any other scientific body. Secondly, the peculiar fact, that our period of maximum activity coincides with that of minimum activity of other scientific bodies, is often of the highest importance. At the very time when the other bodies are least able, we are most able, to give deliberate consideration, and formal sanction, to recommendations whether in the form of applications to Government or otherwise which may arise. In many of these, time is an element so essential,

taking solids in themselves; whereas after the second dimension the third, which is concerned with cubes and dimensions of depth, ought to have been followed.

"It is true, Socrates; but these subjects seem to be as yet hardly explored.

"Why, yes, I said, and for two reasons; in the first place, no government patronises them, which leads to a want of energy in the study of them, and they are difficult; in the second place, students cannot learn them unless they have a teacher. But then a teacher is hardly to be found, and even if one could be found, as matters now stand, the students of these subjects, who are very conceited, would not mind him; that, however, would be otherwise if the whole state patronised and honoured them, then they would listen, and there would be continuous and earnest search, and discoveries would be made; since, even now, disregarded as they are by the world, and maimed of their fair proportions, and although none of their votaries can tell the use of them, still these studies force their way by their natural charm, and very likely they may emerge into light."

that it is not too much to say, that without the intervention of the British Association many opportunities for the advancement of Science, especially at the seasons in question, might have been lost. The Government has moreover formally recognised our scientific existence by appointing our President for the time being a member of the Government Fund Committee; and the public has added its testimony to our importance and utility by imposing upon our President and officers a variety of duties, among which are conspicuous those which arise out of its very liberal exercise of civic and other hospitality.

Of the nature and functions of the Presidential address this is perhaps neither the time nor the place to speak; but if I might for a moment forget the purpose for which we are now assembled, I would take the opportunity of reminding those who have not attended many of our former meetings that our annual volumes contain a long series of addresses on the progress of Science, from a number of our most eminent men, to which there is perhaps no parallel elsewhere. These addresses are perhaps as remarkable for their variety in mode of treatment as for the value of their subject-matter. Some of our Presidents, and especially those who officiated in the earlier days of our existence, have passed in review the various branches of Science, and have noted the progress made in each during the current year. But, as the various Sciences have demanded more and more special treatment on the part of those who seriously pursue them, so have the cases of individuals who can of their own knowledge give anything approaching to a general review become more and more rare. To this may be added the fact that although no year is so barren as to fail in affording sufficient crop for a strictly scientific budget, or for a detailed report of progress in research, yet one year is more fertile than another in growths of sufficient prominence to arrest the attention of the general public, and to supply topics suitable for the address. On these accounts apparently such a Presidential survey has ceased to be annual, and has dropped into an intermittence of longer period. Some Presidents have made a scientific principle, such as the Time-element in natural phenomena, or Continuity, or Natural Selection, the theme of their discourse, and have gathered illustrations from various branches of knowledge. Others again, taking their own special subject as a fundamental note, and thence modulating into other kindred keys, have borne testimony to the fact that no subject is so special as to be devoid of bearing or of influence on many others. Some have described the successive stages of even a single but important investigation; and while tracing the growth of that particular item, and of the ideas involved in it, have incidentally shown to the outer world what manner of business a serious investigation is. But there is happily no pattern or precedent which the President is bound to follow; both in range of subject-matter and in mode of treatment each case has exercised his undoubted right of taking an independent line. And it can hardly be doubted that a judicious exercise of this freedom has contributed more than anything else to sustain the interest of a series of annual discourses extending now over nearly half a century.

The nature of the subjects which may fairly come within the scope of such a discourse has of late been much discussed; and the question is one upon which everyone of course is entitled to form his own judgment; but lest there should be any misapprehension as to how far it concerns us in our corporate capacity, it will be well to remind my hearers that as, on the one hand, there is no discussion on the Presidential address, and the members as a body express no formal opinion upon it, so, on the other, the Association cannot fairly be considered as in any way committed to its tenor or conclusions. Whether this immunity from comment and reply be really on the whole so advantageous to the President as might be supposed need not here be discussed; but suffice it to say, that the case of an audience assembled to listen without discussion finds a parallel elsewhere, and in the parallel case it is not generally considered that the result is altogether either advantageous to the speaker or conducive to excellence in the discourse.

But, apart from this, the question of a limitation of range in the subject-matter for the Presidential address is not quite so simple as may at first sight appear. It must, in fact, be borne in mind that, while on the one hand knowledge is distinct from opinion, from feeling, and from all other modes of subjective impression, still the limits of knowledge are at all times expanding, and the boundaries of the known and the unknown are never rigid or permanently fixed. That which in time past or present has belonged to one category may in time future belong to the other. Our ignorance consists partly in ignorance of actual facts, and partly also in ignorance of the possible range of ascertainable fact. If we could lay down beforehand precise limits of possible knowledge, the problem of Physical Science would be already half solved. But the question to which the scientific explorer has often to address himself is not merely whether he is able to solve this or that problem, but whether he can so far unravel the tangled threads of the matter with which he has to deal as to weave them into a definite problem at all. He is not like a candidate at an examination with a precise set of questions placed before him; he must first himself act the part of the examiner and select questions from the repertory of nature, and upon them found others, which in some sense are capable of definite solution. If his eye seem dim, he must look steadfastly, and with hope into the misty vision, until the very clouds wreath themselves into definite forms. If his ear seem dull, he must listen patiently and with sympathetic trust to the intricate whisperings of nature,—the goddess, as she has been called, of a hundred voices—until here and there he can pick out a few simple notes to which his own powers can resound. If, then, at a moment when he finds himself placed on a pinnacle from which he is called upon to take a perspective survey of the range of science, and to tell us what he can see from his vantage ground; if, at such a moment, after straining his gaze to the very verge of the horizon, and after describing the most distant of well-defined objects, he should give utterance also to some of the subjective impressions which he is conscious of receiving from regions beyond; if he should depict possibilities which seem opening to his view; if he should explain why he thinks this a mere blind alley and that an open path; then the fault and the loss would be alike ours if we refused to listen calmly, and temperately to form our own judgment on what we hear; then assuredly it is we who would be committing the error of confounding matters of fact and matters of opinion if we failed to discriminate between the various elements contained in such a discourse, and assumed that they had all been put on the same footing.

But to whatever decision we may each come on these controverted points, one thing appears clear from a retrospect of past experience, viz., that first or last, either at the outset in his choice of subject or in the conclusions ultimately drawn therefrom, the President, according to his own account at least, finds himself on every occasion in a position of "exceptional or more than usual difficulty." And your present representative, like his predecessors, feels himself this moment in a similar predicament. The reason which he now offers is that the branch of science which he represents is one whose lines of advance, viewed from a mathematician's own point of view, offer so few points of contact with the ordinary experiences of life or modes of thought, that any account of its actual progress which he might have attempted must have failed in the first requisite of an address, namely, that of being intelligible.

Now if this esoteric view had been the only aspect of the subject which he could present to his hearers, he might well have given up the attempt in despair. But although in its technical character Mathematical Science

suffers the inconveniences, while it enjoys the dignity, of its Olympian position, still in a less formal garb, or in disguise, if you are pleased so to call it, it is found present at many an unexpected turn; and although some of us may never have learnt its special language, not a few have, all through our scientific life, and even in almost every accurate utterance, like Molière's well-known character, been talking mathematics without knowing it. It is, moreover, a fact not to be overlooked that the appearance of isolation, so conspicuous in mathematics, appertains in a greater or less degree to all other sciences, and perhaps also to all pursuits in life. In its highest flight each soars to a distance from its fellows. Each is pursued alone for its own sake, and without reference to its connection with, or its application to, any other subject. The pioneer and the advanced guard are of necessity separated from the main body, and in this respect mathematics does not materially differ from its neighbours. And, therefore, as the solitariness of mathematics has been a frequent theme of discourse, it may be not altogether unprofitable to dwell for a short time upon the other side of the question, and to inquire whether there be not points of contact in method or in subject-matter between mathematics and the outer world which have been frequently overlooked; whether its lines do not in some cases run parallel to those of other occupations and purposes of life; and lastly, whether we may not hope for some change in the attitude too often assumed towards it by the representatives of other branches of knowledge and of mental activity.

In his Preface to the "Principia" Newton gives expression to some general ideas which may well serve as the key-note for all future utterances on the relation of mathematics to natural, including also therein what are commonly called artificial, phenomena.

"The ancients divided mechanics into two parts, rational and practical; and since artizans often work inaccurately, it came to pass that mechanics and geometry were distinguished in this way, that everything accurate was referred to geometry, and everything inaccurate to mechanics. But the inaccuracies appertain to the artizan and not to the art, and geometry itself has its foundation in mechanical practice, and is in fact nothing else than that part of universal mechanics which accurately lays down and demonstrates the art of measuring."* He next explains that rational mechanics is the science of motion resulting from forces, and adds, "The whole difficulty of philosophy seems to me to lie in investigating the forces of nature from the phenomena of motion, and in demonstrating that from these forces other phenomena will ensue." Then, after stating the problems of which he has treated in the work itself, he says, "I would that all other natural phenomena might similarly be deduced from mechanical principles. For many things move me to suspect that everything depends upon certain forces in virtue of which the particles of bodies, though forces not yet understood, are either impelled together so as to cohere in regular figures, or are repelled and recede from one another."

Newton's views, then, are clear. He regards mathematics not as a method independent of, though applicable to, various subjects, but as itself the higher side or aspect of the subjects themselves; and it would be little more than a translation of his notions into other language, little more than a paraphrase of his own words, if we were to describe the mathematical as one aspect of the material world itself, apart from which all other aspects are but incomplete sketches, and, however accurate after their own kind, are still liable to the imperfections of the inaccurate artificer. Mr. Burrowes, in his Preface to the first volume of the *Transactions of the Royal Irish Academy*, has carried out the same argument, approaching it from the other side. "No one science," he says, "is so little connected with the rest as not to afford many principles whose use may extend considerably beyond the science to which they primarily belong, and no proposition is so purely theoretical as to be incapable of being applied to practical purposes. There is no apparent connexion between duration and the cycloidal arch, the properties of which have furnished us with the best method of measuring time; and he who has made himself master of the nature and affections of the logarithmic curve has advanced considerably towards ascertaining the proportionable density of the air at various distances from the earth. The researches of the mathematician are the only sure ground on which we can reason from experiments; and how far experimental science may assist commercial interests is evinced by the success of manufactures in countries where the hand of the artificer has taken its direction from the philosopher. Every manufacture is in reality but a chemical process, and the machinery requisite for carrying it on but the right application of certain propositions in rational mechanics." So far your Academician. Every subject, therefore, whether in its usual acceptation, scientific, or otherwise, may have a mathematical aspect; as soon, in fact, as it becomes a matter of strict measurement, or of numerical statement, so soon does it enter upon a mathematical phase. This phase may, or it may not, be a prelude to another in which the laws of the subject are expressed in algebraical formulæ or represented by geometrical figures. But the real gist of the business does not always lie in the mode of expression, and the fascination of the formulæ or other mathematical paraphernalia may after all be little more than that of a theatrical transformation scene. The process of reducing to formulæ is really one of abstraction, the results of which are not always wholly on the side of gain; in fact, through the process itself the subject may lose in one respect even more than it gains in another. But long before such abstraction is completely attained, and even in cases where it is never attained at all, a subject may to all intents and purposes become mathematical. It is not so much elaborate calculations or abstruse processes which characterise this phase as the principles of precision, of exactness, and of proportion. But these are principles with which no true knowledge can entirely dispense. If it be the general scientific spirit which at the outset moves upon the face of the waters, and out of the unknown depth brings forth light and living forms, it is no less the mathematical spirit which breathes the breath of life into what would otherwise have ever remained mere dry bones of fact, which re-unites the scattered limbs and re-creates from them a new and organic whole.

And as a matter of fact, in the words used by Professor Jellett at our meeting at Belfast, viz., "Not only are we applying our methods to many sciences already recognised as belonging to the legitimate province of mathematics, but we are learning to apply the same instrument to sciences hitherto wholly or partially independent of its authority. Physical Science is learning more and more every day to see in the phenomena of Nature modifications of that one phenomenon (namely, Motion) which is peculiarly under the power of mathematics." Echoes are these, far off and faint perhaps, but still true echoes, in answer to Newton's wish that all these phenomena may some day "be deduced from mechanical principles."

If, turning from this aspect of the subject, it were my purpose to enumerate how the same tendency has evinced itself in the Arts, unconsciously it may be to the artists themselves, I might call as witnesses each one in turn with full reliance on the testimony which they would bear. And, having more special reference to mathematics, I might confidently point to the accuracy of measurement, to the truth of curve, which according to modern investigation is the key to the perfection of classic art. I might triumphantly cite not only the architects of all ages, whose art so manifestly rests upon mathematical principles; but I might cite also the literary as well as the artistic remains of the great artists of Cinquecento,

* Compare with this the latter part of Plato's "Philebus," on knowledge and the handicraft arts; also Prof. Jowett's "Introduction" thereto.

both painters and sculptors, in evidence of the geometry and the mechanics which, having been laid at the foundation, appear to have found their way upwards through the superstructure of their works.* And in a less ambitious sphere, but nearer to ourselves in both time and place, I might point with satisfaction to the great school of English constructors of the 18th century in the domestic arts, and remind you that not only the engineer and the architect, but even the cabinet-makers, devoted half the space of their books to perspective and to the principles whereby solid figures may be delineated on paper, or what is now termed descriptive geometry.†

Nor perhaps would the sciences which concern themselves with reasoning and speech, nor the kindred art of Music, nor even Literature itself, if thoroughly probed, offer fewer points of dependence upon the science of which I am speaking. What, in fact, is Logic but that part of universal reasoning; Grammar, but that part of universal speech; Harmony and Counterpoint, but that part of universal music, "which accurately lays down," and demonstrates (so far as demonstration is possible) precise methods appertaining to each of these Arts? And I might even appeal to the common consent which speaks of the mathematical as the pattern form of reasoning and model of a precise style.

Taking, then, precision and exactness as the characteristics which distinguish the mathematical phase of a subject, we are naturally led to expect that the approach to such a phase will be indicated by increasing application of the principle of measurement, and by the importance which is attached to numerical results. And this very necessary condition for progress may, I think, be fairly described as one of the main features of scientific advance in the present day.

If it were my purpose, by descending into the arena of special sciences, to show how the most various investigations alike tend to issue in measurement, and to that extent to assume a mathematical phase, I should be embarrassed by the abundance of instances which might be adduced. I will therefore confine myself to a passing notice of a very few, selecting those which exemplify not only the general tendency, but also the special character of the measurements now particularly required, viz., that of minuteness, and the indirect method by which alone we can at present hope to approach them. An object having a diameter of an 80,000th of an inch is perhaps the smallest of which the microscope could give any well-defined representation; and it is improbable that one of 120,000th of an inch could be singly discerned with the highest powers at our command.‡ But the solar beams and the electric light reveal to us the presence of bodies far smaller than these. And, in the absence of any means of observing them singly, Prof. Tyndall has suggested a scale of these minute objects in terms of the lengths of luminiferous waves. To this he was led, not by any attempt at individual measurement, but by taking account of them in the aggregate, and observing the tints which they scatter laterally when clustered in the form of actinic clouds.‖ The small bodies with which experimental Science has recently come into contact are not confined to gaseous molecules, but comprise also complete organisms; and the same philosopher has made a profound study of the momentous influence exerted by these minute organisms in the economy of life.§ And if, in view of their specific effects, whether deleterious or other, on human life, any qualitative classification or quantitative estimate be ever possible, it seems that it must be effected by some such method as that indicated above.

Again, to enumerate a few more instances of the measurement of minute quantities, there are the average distances of molecules from one another in various gases and at various pressures; the length of their free path, or range open for their motion without coming into collision; there are movements causing the pressures and differences of pressure under which Mr. Crookes's radiometers execute their wonderful revolutions.* There are the excursions of the air while transmitting notes of high pitch, which through the researches of Lord Rayleigh appear to be of a diminutiveness altogether unexpected.† There are the molecular actions brought into play in the remarkable experiments by Dr. Kerr,‡ who has succeeded, where even Faraday failed, in effecting a visible rotation of the plane of polarisation of light in its passage through electrified dielectrics, and on its reflexion at the surface of a magnet. To take one more instance, which must be present to the minds of us all, there are the infinitesimal ripples of the vibrating plate in Mr. Graham Bell's most marvellous invention. Of the nodes and ventral segments in the plate of the telephone which actually converts sound into electricity and electricity into sound, we can at present form no conception. All that can now be said is that the most perfect specimens of Chladni's sand figures on a vibrating plate, or of Kundt's lycopodium heaps in a musical tube,‖ or even Mr. Sedley Taylor's more delicate vortices in the films of the Phoneidoscope,§ are rough and sketchy compared with these. For notwithstanding the fact that in the movements of the Telephone-plate we have actually in our hand the solution of that Old World problem, the construction of a speaking machine, yet the characters in which that solution is expressed are too small for our powers of decipherment. In movements such as these we seem to lose sight of the distinction, or perhaps we have unconsciously passed the boundary between massive and molecular motion.¶

Through the Phonograph** we have not only a transformation, but a permanent and tangible record of the mechanism of speech. But the differences upon which articulation (apart from loudness, pitch, and quality) depends, appear from the experiments of Fleeming Jenkin and of others to be of microscopic size.†† The Microphone affords another instance of the unexpected value of minute variations—in this case of electric currents; and it is remarkable that the gist of the instrument seems to lie in obtaining and perfecting that which electricians have hitherto most scrupulously avoided, viz., loose contact.

Once more, Mr. De la Rue has brought forward as one of the results derived from his stupendous battery of 10,000 cells, strong evidence for supposing that a voltaic discharge, even when apparently continuous, may still be an intermittent phenomenon; but all that is known of the period of such intermittence is, that it must recur at exceedingly short intervals. And in connexion with this subject it may be added that, whatever be the ultimate explanation of the strange stratification which the voltaic discharge undergoes in rarefied gases, it is clear that the alternate disposition of light and darkness must be dependent on some periodic distribution in space or sequence in time which can at present be dealt with only in a very general way. In the exhausted column we have a vehicle for electricity not constant like an ordinary conductor, but itself modified by the passage of the discharge, and perhaps subject to laws differing materially from those which it obeys at atmospheric pressure. It may also be that some of the features accompanying stratification form a

* See "Trattato della Pittura, by Leonardo da Vinci; also the 'Memoir on the MSS. of L. d. V.," by Venturi, 1797.

† "The Gentleman and Cabinet Maker's Director," by Thomas Chippendale; London, 1754. "The Cabinet Maker and Upholsterer's Drawing Book," by Thomas Sheraton; London, 1793.

‡ See Sorby's "Address to the Microscopical Society," 1876.

‖ *Phil. Trans. of the Royal Society*, 1870, p. 333; and 1876, p. 27.

§ *Phil. Trans.*, 1877, p. 149.

* "On Attraction and Repulsion resulting from Radiation," *Phil. Trans.*, 1874, p. 501; 1875, p. 519; 1876, p. 325.

† *Philosophical Magazine*, April, 1878.

‡ *Phil. Mag.*, 1875, vol. ii., pp. 337, 446; 1877, vol. i., p. 321; 1878, vol. i., p. 161.

‖ *Poggendorff's Annalen*, tom. xxxv., p. 337.

§ *Proceedings of Royal Society*, 1878.

¶ The Papers on the Telephone are too numerous to specify.

** See various Papers in *Nature*, and elsewhere, during the last twelve months.

†† *Phil. Trans.*, vol. clxix., pp. 55 and 155, and other Papers catalogued in the "Appendix to Part II. of the Memoir."

magnified image of phenomena belonging to disruptive discharges in general, and that consequently, so far from expecting among the known facts of the latter any clue to an explanation of the former, we must hope ultimately to find in the former an elucidation of what is at present obscure in the latter. A prudent philosopher usually avoids hazarding any forecast of the practical application of a purely scientific research. But it would seem that the configuration of these striæ might some day prove a very delicate means of estimating low pressures, and perhaps also for effecting some electrical measurements.

Now, it is a curious fact that almost the only small quantities of which we have as yet any actual measurements are the wave-lengths of light, and that all others, excepting so far as they can be deduced from these, await future determination. In the meantime, when unable to approach these small quantities individually, the method to which we are obliged to have recourse is, as indicated above, that of averages, whereby, disregarding the circumstances of each particular case, we calculate the average size, the average velocity, the average direction, &c., of a large number of instances.* But although this method is based upon experience, and leads to results which may be accepted as substantially true; although it may be applicable to any finite interval of time, or over any finite area of space (that is, for all practical purposes of life), there is no evidence to show that it is so when the dimensions of interval or of area are indefinitely diminished. The truth is that the simplicity of Nature which we at present grasp is really the result of infinite complexity, and that below the uniformity there underlies a diversity whose depths we have not yet probed, and whose secret places are still beyond our reach.

The present is not an occasion for multiplying illustrations, but I can hardly omit a passing allusion to one all-important instance of the application of the statistical method. Without its aid social life, or the History of Life and Death, could not be conceived at all, or only in the most superficial manner. Without it we could never attain to any clear ideas of the condition of the Poor, we could never hope for any solid amelioration of their condition or prospects. Without its aid sanitary measures, and even medicine, would be powerless. Without it the politician and the philanthropist would alike be wandering over a trackless desert.

It is, however, not so much from the side of Science at large as from that of Mathematics itself that I desire to speak. I wish from the latter point of view to indicate connexions between Mathematics and other subjects, to prove that hers is not after all such a far-off region, nor so undecipherable an alphabet, and to show that even at unlikely spots we may trace under-currents of thought which, having issued from a common source, fertilise alike the mathematical and the non-mathematical world.

Having this in view I propose to make the subject of special remark some processes peculiar to modern Mathematics; and, partly with the object of incidentally removing some current misapprehensions, I have selected for examination three methods in respect of which mathematicians are often thought to have exceeded all reasonable limits of speculation, and to have adopted for unknown purposes an unknown tongue. And it will be my endeavour to show not only that in these very cases our science has not outstepped its own legitimate range, but that even art and literature have unconsciously employed methods similar in principle. The three methods in question are, first, that of Imaginary Quantities; secondly, that of Manifold Space; and thirdly, that of Geometry not according to Euclid.

First it is objected that, abandoning the more cautious methods of ancient mathematicians, we have admitted into our formulæ quantities which by our own showing, and even in our own nomenclature, are imaginary or impossible; nay, more, that out of them we have formed a variety of new algebras to which there is no counterpart whatever in reality; but from which we claim to arrive at possible and certain results.

On this head it is in Dublin, if anywhere, that I may be permitted to speak. For to the fertile imagination of the late Astronomer Royal for Ireland we are indebted for that marvellous Calculus of Quaternions which is only now beginning to be fully understood, and which has not yet received all the applications of which it is doubtless capable. And even although this calculus be not co-extensive with another which almost simultaneously germinated on the Continent,* nor with ideas more recently developed in America, yet it must always hold its position as an original discovery,† and as a representative of one of the two great groups of generalised algebras (viz., those the squares of whose units are respectively negative unity and zero), the common origin of which must still be marked on our intellectual map as an unknown region. Well do I recollect how in its early days we used to handle the method as a magician's page might try to wield his master's wand, trembling as it were between hope and fear, and hardly knowing whether to trust our own results until they had been submitted to the present and ever-ready counsel of Sir W. R. Hamilton himself.

To fix our ideas, consider the measurement of a line, or the reckoning of time, or the performance of any mathematical operation. A line may be measured in one direction or in the opposite; time may be reckoned forward or backward: an operation may be performed or be reversed, it may be done or may be undone; and if having once reversed any of these processes we reverse it a second time, we shall find that we have come back to the original direction of measurement or of reckoning, or to the original kind of operation.

Suppose, however, that at some stage of a calculation our formulæ indicate an alteration in the mode of measurement such that, if the alteration be repeated, a condition of things not the same as, but the reverse of, the original will be produced. Or suppose that, at a certain stage, our transformations indicate that time is to be reckoned in some manner different from future or past, but still in a way having definite algebraical connexion with time which is gone and time which is to come. It is clear that in actual experience there is no process to which such measurements correspond.‡ Time has no meaning except as future or past; and the present is but the meeting point of the two. Or, once more, suppose that we are gravely told that all circles pass through the same two imaginary points at an infinite distance, and that every line drawn through one of these points is perpendicular to itself. On hearing the statement we shall probably whisper, with a smile or a sigh, that we hope it is not true; but that in any case it is a long way off, and perhaps, after all, it does not very much signify. If, however, as mathematicians we are not satisfied to dismiss the question on these terms, we ourselves must admit that we have here reached a definite point of issue. Our science must either give a rational account of the dilemma or yield the position as no longer tenable.

Special modes of explaining this anomalous state of things have occurred to mathematicians. But, omitting details as unsuited to the present occasion, it will, I think,

* See Maxwell "On Heat," chap. xxii.

* Grunert's "Archiv," vol. vi., p. 337; also separate work, Berlin, 1862.

† "Linear Associative Algebra," by Benjamin Peirce; Washington City, 1870.

‡ Sir W. Thomson, *Cambridge Mathematical Journal*, vol. iii., p. 174. Jevons's "Principles of Science," vol. ii., p. 438. But an explanation of the difficulty seems to me to be found in the fact that the problem, as stated, is one of the conduction of heat, and that the "impossibility" which attaches itself to the expression for the "time" merely means that previous to a certain epoch the conditions which gave rise to the phenomena were not those of conduction, but those of some other action of heat. If, therefore, we desire to comprise the phenomena of the earlier as well as of the later period in one problem, we must find some more general statement, viz., that of physical conditions which at the critical epoch will issue in a case of conduction. I think that Prof. Clifford has somewhere given a similar explanation.

be sufficient to point out in general terms that a solution of the difficulty is to be found in the fact that the formulæ which give rise to these results are more comprehensive than the signification assigned to them; and when we pass out of the condition of things first contemplated, they cannot (as it is obvious they ought not) give us any results intelligible on that basis. But it does not therefore by any means follow that upon a more enlarged basis the formulæ are incapable of interpretation; on the contrary, the difficulty at which we have arrived indicates that there must be some more comprehensive statement of the problem which will include cases impossible in the more limited, but possible in the wider, view of the subject.

A very simple instance will illustrate the matter. If from a point outside a circle we draw a straight line to touch the curve, the distance between the starting-point and the point of contact has certain geometrical properties. If the starting-point be shifted nearer and nearer to the circle the distance in question becomes shorter, and ultimately vanishes. But as soon as the point passes to the interior of the circle the notion of a tangent and distance to the point of contact cease to have any meaning; and the same anomalous condition of things prevails as long as the point remains in the interior. But if the point be shifted still further, until it emerges on the other side, the tangent and its properties resume their reality, and are as intelligible as before. Now the process whereby we have passed from the possible to the impossible, and again re-passed to the possible (namely, the shifting of the starting-point) is a perfectly continuous one, while the conditions of the problem as stated above have abruptly changed. If, however, we replace the idea of a line touching by that of a line cutting the circle, and the distance of the point of contact by the distances at which the line is intercepted by the curve, it will easily be seen that the latter includes the former as a limiting case, when the cutting line is turned about the starting-point until it coincides with the tangent itself. And further, that the two intercepts have a perfectly distinct and intelligible meaning whether the point be outside or inside the area. The only difference is that in the first case the intercepts are measured in the same direction; in the latter in opposite directions.

The foregoing instance has shown one purpose which these imaginaries may serve, viz., as marks indicating a limit to a particular condition of things, to the application of a particular law, or pointing out a stage where a more comprehensive law is required. To attain to such a law we must, as in the instance of the circle and tangent, reconsider our statement of the problem; we must go back to the principle from which we set out, and ascertain whether it may not be modified or enlarged. And even if in any particular investigation, wherein imaginaries have occurred, the most comprehensive statement of the problem of which we are at present capable fails to give an actual representation of these quantities; if they must for the present be relegated to the category of imaginaries; it still does not follow that we may not at some future time find a law which will endow them with reality, nor that in the meantime we need hesitate to employ them, in accordance with the great principle of continuity, for bringing out correct results.

If, moreover, both in Geometry and in Algebra we occasionally make use of points or of quantities, which from our present outlook have no real existence, which can neither be delineated in space of which we have experience nor measured by scale as we count measurement; if these imaginaries, as they are termed, are called up by legitimate processes of our science; if they serve the purpose not merely of suggesting ideas, but of actually conducting us to practical conclusions; if all this be true in abstract science, I may perhaps be allowed to point out, in illustration of my argument, that in Art unreal forms are frequently used for suggesting ideas, for conveying a meaning for which no others seem to be suitable or adequate. Are not forms unknown to Biology, situations incompatible with gravitation, positions which challenge not merely the stability but even the possibility of equilibrium,—are not these the very means to which the artist often has recourse in order to convey his meaning and to fulfil his mission? Who that has ever revelled in the ornamentation of the Renaissance, in the extraordinary transitions from the animal to the vegetable, from faunic to floral forms, and from these again to almost purely geometric curves, who has not felt that these imaginaries have a claim to recognition very similar to that of their congeners in mathematics? How is it that the grotesque paintings of the Middle Ages, the fantastic sculpture of remote nations, and even the rude art of the pre-historic past, still impress us, and have an interest over and above their antiquarian value; unless it be that they are symbols which, although hard of interpretation when taken alone, are yet capable from a more comprehensive point of view of leading us mentally to something beyond themselves, and to truths which, although reached through them, have a reality scarcely to be attributed to their outward forms?

Again, if we turn from Art to Letters, truth to nature and to fact is undoubtedly a characteristic of sterling literature; and yet in the delineation of outward nature itself, still more in that of feelings and affections, of the secret parts of character and motives of conduct, it frequently happens that the writer is driven to imagery, to an analogy, or even to a paradox, in order to give utterance to that of which there is no direct counterpart in recognised speech. And yet which of us cannot find a meaning for these literary figures, an inward response to imaginative poetry, to social fiction, or even to those tales of giant and fairyland written, it is supposed, only for the nursery or schoolroom? But in order thus to reanimate these things with a meaning beyond that of the mere words, have we not to reconsider our first position, to enlarge the ideas with which we started; have we not to cast about for some thing which is common to the idea conveyed and to the subject actually described, and to seek for the sympathetic spring which underlies both; have we not, like the mathematician, to go back as it were to some first principles, or, as it is pleasanter to describe it, to become again as a little child?

Passing to the second of the three methods, viz., that of Manifold Space, it may first be remarked that our whole experience of space is in three dimensions, viz., of that which has length, breadth, and thickness; and if for certain purposes we restrict our ideas to two dimensions as in plane geometry, or to one dimension as in the division of a straight line, we do this only by consciously and of deliberate purpose setting aside, but not annihilating, the remaining one or two dimensions. Negation, as Hegel has justly remarked, implies that which is negatived, or, as he expresses it, affirms the opposite. It is by abstraction from previous experience, by a limitation of its results, and not by any independent process, that we arrive at the idea of space whose dimensions are less than three.

It is doubtless on this account that problems in plane geometry which, although capable of solution on their own account, become much more intelligible, more easy of extension, if viewed in connection with solid space, and as special cases of corresponding problems in solid geometry. So eminently is this the case, that the very language of the more general method often leads us almost intuitively to conclusions which, from the more restricted point of view, require long and laborious proof. Such a change in the base of operations has, in fact, been successfully made in geometry of two dimensions, and although we have not the same experimental data for the further steps, yet neither the modes of reasoning, nor the validity of its conclusions, are in any way affected by applying an analogous mental process to geometry of three dimensions; and by regarding figures in space of three dimensions as sections of figures in space of four, in the same way that figures in plano are sometimes considered as sections of figures in solid space. The addition of a fourth dimension to space not only extends the actual

properties of geometrical figures, but it also adds new properties which are often useful for the purposes of transformation or of proof. Thus it has recently been shown that in four dimensions a closed material shell could be turned inside out by simple flexure, without either stretching or tearing;* and that in such a space it is impossible to tie a knot.†

Again, the solution of problems in geometry is often effected by means of algebra; and as three measurements, or co-ordinates as they are called, determine the position of a point in space, so do three letters or measureable quantities serve for the same purpose in the language of algebra. Now, many algebraical problems involving three unknown or variable quantities admit of being generalised so as to give problems involving many such quantities. And as, on the one hand, to every algebraical problem involving unknown quantities or variables by ones, or by twos, or by threes, there corresponds a problem in geometry of one or of two or of three dimensions; so on the other, it may be said that to every algebraical problem involving many variables there corresponds a problem in geometry of many dimensions.

There is, however, another aspect under which even ordinary space presents to us a four-fold, or indeed a manifold, character. In modern Physics, space is regarded, not as a vacuum in which bodies are placed and forces have play, but rather as a plenum with which matter is coextensive. And from a physical point of view the properties of space are the properties of matter, or of the medium which fills it. Similarly, from a mathematical point of view, space may be regarded as a *locus in quo*, as a plenum, filled with those elements of geometrical magnitude which we take as fundamental. These elements need not always be the same. For different purposes different elements may be chosen; and upon the degree of complexity of the subject of our choice will depend the internal structure or mani-foldness of space.

Thus, beginning with the simplest case, a point may have any singly infinite multitude of positions in a line, which gives a one-fold system of points in a line. The line may revolve in a plane about any one of its points, giving a two-fold system of points in a plane; and the plane may revolve about any one of the lines, giving a three-fold system of points in space.

Suppose, however, that we take a straight line as our element, and conceive space as filled with such lines. This will be the case if we take two planes, *e.g.*, two parallel planes, and join every point in one with every point in the other. Now the points in a plane form a two-fold system, and it therefore follows that the system of lines is four-fold; in other words, space regarded as a plenum of lines is four-fold. The same result follows from the consideration that the lines in a plane, and the planes through a point, are each two-fold.

Again, if we take a sphere as our element we can through any point as a centre draw a singly infinite number of spheres, but the number of such centres is triply infinite; hence space as a plenum of spheres is four-fold. And, generally, space as a plenum of surfaces has a mani-foldness equal to the number of constants required to determine the surface. Although it would be beyond our present purpose to attempt to pursue the subject further, it should not pass unnoticed that the identity in the four-fold character of space, as derived on the one hand from a system of straight lines, and on the other from a system of spheres, is intimately connected with the principles established by Sophus Lie in his researches on the correlation of these figures.

If we take a circle as our element we can around any point in a plane as a centre draw a singly infinite system of circles; but the number of such centres in a plane is doubly infinite; hence the circles in a plane form a three-fold system, and as the planes in space form a three-fold system, it follows that space as a plenum of circles is six-fold.

Again, if we take a circle as our element, we may regard it as a section either of a sphere or of a right cone (given except in position) by a plane perpendicular to the axis. In the former case the position of the centre is four-fold; the directions of the plane, like that of a pencil of lines perpendicular thereto, two-fold; and the radius of the sphere one-fold; six-fold in all. In the latter case, the position of the vertex is three-fold; the direction of the axis two-fold; and the distance of the plane of section one-fold: six-fold in all, as before. Hence space as a plenum of circles is six-fold.

Similarly, if we take a conic as our element, we may regard it as a section of a right cone (given except in position) by a plane. If the nature of the conic be defined, the plane of section will be inclined at a fixed angle to the axis; otherwise it will be free to take any inclination whatever. This being so, the position of the vertex will be three-fold; the direction of the axis two-fold; the distance of the plane of section from the vertex one-fold; and the direction of that plane one-fold if the conic be defined, two-fold if it be not defined. Hence, space as a plenum of definite conics will be seven-fold, as a plenum of conics in general eight-fold. And so on for curves of higher degrees.

This is in fact the whole story and mystery of manifold space. It is not seriously regarded as a reality in the same sense as ordinary space; it is a mode of representation, or a method which, having served its purpose, vanishes from the scene. Like a rainbow, if we try to grasp it, it eludes our very touch; but, like a rainbow, it arises out of real conditions of known and tangible quantities, and if rightly apprehended it is a true and valuable expression of natural laws, and serves a definite purpose in the science of which it forms part.

Again, if we seek a counterpart of this in common life, I might remind you that perspective in drawing is itself a method not altogether dissimilar to that of which I have been speaking; and that the third dimension of space, as represented in a picture, has its origin in the painter's mind, and is due to his skill, but has no real existence upon the canvass which is the groundwork of his art. Or again, turning to literature, when in legendary tales, or in works of fiction, things past and future are pictured as present, has not the poetic fancy correlated time with the three dimensions of space, and brought all alike to a common focus? Or, once more, when space already filled with material substances is mentally peopled with immaterial beings, may not the imagination be regarded as having added a new element to the capacity of space, a fourth dimension of which there is no evidence in experimental fact?

The third method proposed for special remark is that which has been termed Non-Euclidean Geometry; and the train of reasoning which has led to it may be described in general terms as follows:—Some of the properties of space, which on account of their simplicity, theoretical as well as practical, have, in constructing the ordinary system of geometry, been considered as fundamental, are now seen to be particular cases of more general properties. Thus a plane surface and a straight line may be regarded as special instances of surfaces and lines whose curvature is everywhere uniform or constant. And it is perhaps not difficult to see that, when the special notions of flatness and straightness are abandoned, many properties of geometrical figures which we are in the habit of regarding as fundamental will undergo profound modification. Thus a plane may be considered as a special case of the sphere, viz., the limit to which a sphere approaches when its radius is increased without limit. But even this consideration trenches upon an elementary proposition relating to one of the simplest of geometrical figures. In plane triangles the interior angles are together equal to two right angles; but in triangles traced on the surface of a sphere this pro-

* S. Newcomb, "On Certain Transformations of Surfaces," *American Journal of Mathematics*, vol. i., p. 1.

† Tait "On Knots," *Transactions of the Royal Society of Edinburgh*, vol. xxviii., p. 145; Klein, *Mathematische Annalen*, ix., p. 478.

position does not hold good. To this other instances might be added.

Further, these modifications may affect not only our ideas of particular geometrical figures, but the very axioms of the science itself. Thus, the idea, which in fact lies at the foundation of Euclid's method, viz., that a geometrical figure may be moved in space without change of size or alteration of form, entirely falls away, or becomes only approximate in a space wherein dimension and form are dependent upon position. For instance, if we consider merely the case of figures traced on a flattened globe like the earth's surface, or upon an eggshell, such figures cannot be made to slide upon the surface without change of form, as is the case with figures traced upon a plane or even upon a sphere. But, further still, these generalisations are not restricted to the case of figures traced upon a surface: they may also apply to solid figures in a space whose very configuration varies from point to point. We may, for instance, imagine a space in which our rule or scale of measurement varies as it extends, or as it moves about, in one direction or another; a space, in fact, whose geometric density is not uniformly distributed. Thus we might picture to ourselves such a space as a field having a more or less complicated distribution of temperature, and our scale as a rod instantaneously susceptible of expansion or contraction under the influence of heat: or we might suppose space to be even crystalline in its geometric formation, and our scale and measuring instruments to accept the structure of the locality in which they are applied. These ideas are doubtless difficult of apprehension, at all events at the outset; but Helmholtz has pointed out a very familiar phenomenon which may be regarded as a diagram of such a kind of space. The picture formed by reflexion from a plane mirror may be taken as a correct representation of ordinary space, in which, subject to the usual laws of perspective, every object appears in the same form and of the same dimensions whatever be its position. In like manner, the picture formed by reflexion from a curved mirror may be regarded as the representation of a space wherein dimension and form are dependent upon position. Thus in an ordinary convex mirror objects appear smaller as they recede laterally from the centre of the picture; straight lines become curved; objects infinitely distant in front of the mirror appear at a distance only equal to the focal length behind. And by suitable modifications in the curvature of the mirror, representations could similarly be obtained of space of various configurations.

The diversity in kind of these spaces is of course infinite; they vary with the mode in which we generalise our conceptions of ordinary space; but upon each as a basis it is possible to construct a consistent system of geometry, whose laws, as a matter of strict reasoning, have a validity and truth not inferior to those with which we are habitually familiar. Such systems having been actually constructed, the question has not unnaturally been asked whether there is anything in nature or in the outer world to which they correspond; whether, admitting that for our limited experience ordinary geometry amply suffices, we may understand that for powers more extensive in range or more minute in definition some more general scheme would be requisite? Thus, for example, although the one may serve for the solar system, is it legitimate to suppose that it may fail to apply at distances reaching to the fixed stars or to regions beyond? Or, again, if our vision could discern the minute configuration of portions of space, which to our ordinary powers appear infinitesimally small, should we expect to find that all our usual Geometry is but a special case, sufficient indeed for daily use, but after all only a rough approximation to a truer although perhaps more complicated scheme? Traces of these questions are in fact to be found in the writings of some of our greatest and most original mathematicians. Gauss, Riemann, and Helmholtz have thrown out suggestions radiating as it were in these various directions from a common centre; while Cayley, Sylvester, and Clifford in this country, Klein in Germany, Lobatcheffsky in Russia, Bolyai in Hungary, and Beltrami in Italy, with many others, have reflected kindred ideas with all the modifications due to the chromatic dispersion of their individual minds. But to the main question the answer must be in the negative. And, to use the words of Newton, since "Geometry has its foundation in mechanical practice," the same must be the answer until our experience is different from what it now is. And yet, all this notwithstanding, generalised conceptions of space are not without their practical utility. The principle of representing space of one kind by that of another, and figures belonging to one by their analogues in the other, is not only recognised as legitimate in pure mathematics, but has long found its application in cartography. In maps or charts, geographical positions, the contour of coasts, and other features, belonging in reality to the earth's surface, are represented on the flat; and to each mode of representation, or projection as it is called, there corresponds a special correlation between the spheroid and the plane. To this might perhaps be added the method of descriptive geometry, and all similar processes in use by engineers, both military and civil.

It has often been asked whether modern research in the field of Pure Mathematics has not so completely outstripped its physical applications as to be practically useless; whether the analyst and the geometer might not now, and for a long time to come, fairly say, "hic artem remumque repono," and turn his attention to Mechanics and to Physics. That the Pure has outstripped the Applied is largely true; but that the former is on that account useless is far from true. Its utility often crops up at unexpected points; witness the aids to classification of physical quantities, furnished by the ideas (of Scalar and Vector) involved in the Calculus of Quarternions; or the advantages which have accrued to Physical Astronomy from Lagrange's Equations, and from Hamilton's Principle of Varying Action; on the value of Complex Quantities, and the properties of general Integrals, and of general theorems on integration for the Theories of Electricity and Magnetism. The utility of such researches can in no case be discounted, or even imagined beforehand. Who, for instance, would have supposed that the Calculus of Forms or the Theory of Substitutions would have thrown much light upon ordinary equations; or that Abelian Functions and Hyperelliptic Transcendents would have told us anything about the properties of curves; or that the Calculus of Operations would have helped us in any way towards the figure of the Earth? But upon such technical points I must not now dwell. If, however, as I hope, it has been sufficiently shown that any of these more extended ideas enable us to combine together, and to deal with as one, properties and processes which from the ordinary point of view present marked distinctions, then they will have justified their own existence; and in using them we shall not have been walking in a vain shadow, nor disquieting our brains in vain.

These extensions of mathematical ideas would, however, be overwhelming if they were not compensated by some simplifications in the processes actually employed. Of these aids to calculation I will mention only two, viz., symmetry of form and mechanical appliances; or, say, Mathematics as a Fine Art, and Mathematics as a Handicraft. And first, as to symmetry of form. There are many passages of algebra in which long processes of calculation at the outset seem unavoidable. Results are often obtained in the first instance through a tangled maze of formulæ, where at best we can just make sure of our process step by step, without any general survey of the path which we have traversed, and still less of that which we have to pursue. But almost within our own generation a new method has been devised to clear this entanglement. More correctly speaking, the method is not new, for it is inherent in the processes of algebra itself, and instances of it, unnoticed perhaps or disregarded, are to be found cropping up throughout nearly all mathematical treatises.

By Lagrange, and to some extent also by Gauss, among the older writers, the method of which I am speaking was recognised as a principle; but beside these perhaps no others can be named until a period within our own recollection. The method consists in symmetry of expression. In algebraical formulæ combinations of the quantities entering therein occur and recur; and by a suitable choice of these quantities the various combinations may be rendered symmetrical, and reduced to a few well known types. This having been done, and one such combination having been calculated, the remainder, together with many of their results, can often be written down at once, without further calculations, by simple permutations of the letters. Symmetrical expressions, moreover, save as much time and trouble in reading as in writing. Instead of wading laboriously through a series of expressions which, although successively dependent, bear no outward resemblance to one another, we may read off symmetrical formulæ, of almost any length, at a glance. A page of such formulæ becomes a picture: known forms are seen in definite groupings; their relative positions, or perspective as it may be called, their very light and shadow, convey their meaning almost as much through the artistic faculty as through any conscious ratiocinative process. Few principles have been more suggestive of extended ideas or of new views and relations than that of which I am now speaking. In order to pass from questions concerning plane figures to those which appertain to space, from conditions having few degrees of freedom to others which have many—in a word, from more restricted to less restricted problems—we have in many cases merely to add lines and columns to our array of letters or symbols already formed, and then read off pictorially the extended theorems.

Next as to mechanical appliances. Mr. Babbage, when speaking of the difficulty of ensuring accuracy in the long numerical calculations of theoretical astronomy, remarked, that the science which in itself is the most accurate and certain of all had, through these difficulties, become inaccurate and uncertain in some of its results. And it was doubtless some such consideration as this, coupled with his dislike of employing skilled labour where unskilled would suffice, which led him to the invention of his calculating machines. The idea of substituting mechanical for intellectual power has not lain dormant; for beside the arithmetical machines whose name is legion (from Napier's Bones, Earl Stanhope's calculator, to Schultz and Thomas's machines now in actual use) an invention has lately been designed for even a more difficult task. Prof. James Thomson has in fact recently constructed a machine which, by means of the mere friction of a disk, a cylinder, and a ball, is capable of effecting a variety of the complicated calculations which occur in the highest application of mathematics to physical problems.* By its aid it seems that an unskilled labourer may, in a given time, perform the work of ten skilled arithmeticians. The machine is applicable alike to the calculation of tidal, of magnetic, of meteorological, and perhaps also of all other periodic phenomena. It will solve differential equations of the second and perhaps of even higher orders. And through the same invention the problem of finding the free motions of any number of mutually attracting particles, unrestricted by any of the approximate suppositions required in the treatment of the Lunar and Planetary Theories, is reduced to the simple process of turning a handle.

When Faraday had completed the experimental part of a physical problem, and desired that it should thenceforward be treated mathematically, he used irreverently to say, "Hand it over to the calculators." But truth is ever stranger than fiction; and if he had lived until our day, he might with perfect propriety have said, "Hand it over to the machine."

Had time permitted, the foregoing topics would have led me to point out that the mathematician, although concerned only with abstractions, uses many of the same methods of research as are employed in other sciences, and in the arts, such as observation, experiment, induction, imagination. But this is the less necessary because the subject has been already handled very ably, although with greater brevity than might have been wished, by Professor Sylvester in his address to Section A. at our meeting at Exeter.

In an exhaustive treatment of my subject there would still remain a question which in one sense lies at the bottom of all others, and which through almost all time has had an attraction for reflective minds, viz., What was the origin of mathematical ideas? Are they to be regarded as independent of, or dependent upon, experience? The question has been answered sometimes in one way and sometimes in another. But the absence of any satisfactory conclusion may after all be understood as implying that no answer is possible in the sense in which the question is put; or rather that there is no question at all in the matter, except as to the history of actual facts. And, even if we distinguish, as we certainly should, between the origin of ideas in the individual and their origin in a nation or mankind, we should still come to the same conclusion. If we take the case of the individual, all we can do is to give an account of our own experience; how we played with marbles and apples; how we learnt the multiplication table, fractions, and proportion; how we were afterwards amused to find that common things conformed to the rules of number; and later still, how we came to see that the same laws applied to music and to mechanism, to astronomy, to chemistry, and to many other subjects. And then, on trying to analyse our own mental processes, we find that mathematical ideas have been imbibed in precisely the same way as all other ideas, viz., by learning, by experience, and by reflexion. The apparent difference in the mode of first apprehending them and in their ultimate cogency arises from the difference of the ideas themselves, from the preponderance of quantitative over qualitative considerations in mathematics, from the notions of absolute equality and identity which they imply.

If we turn to the other question, How did the world at large acquire and improve its idea of number and of figures? How can we span the interval between the savage who counted only by the help of outward objects, to whom 15 was "half the hands and both the feet," and Newton or Laplace? The answer is the history of mathematics and its successive developments, arithmetic, geometry, algebra, &c. The first and greatest step in all this was the transition from number in the concrete to number in the abstract. This was the beginning not only of mathematics but of all abstract thought. The reason and mode of it was the same as in the individual. There was the same general influx of evidence, the same unsought-for experimental proof, the same recognition of general laws running through all manner of purposes and relations of life. No wonder then if, under such circumstances, mathematics, like some other subjects and perhaps with better excuse, came after a time to be clothed with mysticism; nor that, even in modern times, they should have been placed upon an *à priori* basis, as in the philosophy of Kant. Number was so soon found to be a principle common to many branches of knowledge that it was readily assumed to be the key to all. It gave distinctness of expression, if not clearness of thought, to ideas which were floating in the untutored mind, and even suggested to it new conceptions. In "the one," "the all," "the many in one," (terms of purely arithmetic origin,) it gave the earliest utterance to men's first crude notions about God and the world. In "the equal," "the solid," "the straight," and "the crooked," which still survive as figures of speech among ourselves, it supplied a vocabulary for the moral notions of mankind, and quickened them by giving them the power of expression. In this lies the great and enduring interest in the fragments which remain to us of the Pythagorean philosophy.

* *Proceedings of the Royal Society*, Feb. 3, 1876, and May 9, 1878.

The consecutive processes of Mathematics led to the consecutive processes of Logic; but it was not until long after mankind had attained to abstract ideas that they attained to any clear notion of their connection with one another. In process of time the leading ideas of Mathematics became the leading ideas of Logic. The "one" and the "many" passed into the "whole" and its "parts;" and thence into the "universal" and the "particular." The fallacies of Logic, such as the well-known puzzle of Achilles and the tortoise, partake of the nature of both sciences. And perhaps the conception of the infinite and the infinitesimal, as well as of negation, may have been in early times transferred from Logic to Mathematics. But the connection of our ideas of number is probably anterior to the connection of any of our other ideas. And as a matter of fact, geometry and arithmetic had already made considerable progress when Aristotle invented the syllogism.

General ideas there were, beside those of mathematics—true flashes of genius which saw that there must be general laws to which the universe conforms, but which saw them only by occasional glimpses, and through the distortion of imperfect knowledge; and although the only records of them now remaining are the inadequate representations of later writers, yet we must still remember that to the existence of such ideas is due not only the conception, but even the possibility of Physical Science. But these general ideas were too wide in their grasp, and in early days at least were connected to their subjects of application by links too shadowy, to be thoroughly apprehended by most minds; and so it came to pass that one form of such an idea was taken as its only form, one application of it as the idea itself; and philosophy, unable to maintain itself at the level of ideas, fell back upon the abstractions of sense, and, by preference, upon those which were most ready to hand, namely, those of mathematics. Plato's ideas relapsed into a doctrine of numbers; mathematics into mysticism, into neo-Platonism, and the like. And so, through many long ages, through good report and evil report, mathematics have always held an unsought-for sway. It has happened to this science as to many other subjects, that its warmest adherents have not always been its best friends. Mathematics have often been brought into matters where their presence has been of doubtful utility. If they have given precision to literary style, that precision has sometimes been carried to excess, as in Spinoza and perhaps Descartes; if they have tended to clearness of expression in philosophy, that very clearness has sometimes given an appearance of finality not always true; if they have contributed to definition in theology, that definiteness has often been fictitious, and has been attained at the cost of spiritual meaning. And, coming to recent times, although we may admire the ingenuity displayed in the logical machines* of Earl Stanhope and of Stanley Jevons, in the "Formal Logic" of De Morgan, and in the "Calculus" of Boole;† although as mathematicians we may feel satisfaction that these feats (the possibility of which was clear *à priori*) have been actually accomplished; yet we must bear in mind that their application is really confined to cases where the subject matter is perfectly uniform in character, and that beyond this range they are liable to encumber rather than to assist thought.

Not unconnected with this intimate association of ideas and their expression is the fact that, whichever may have been cause, whichever effect, or whether both may not in turn have acted as cause and effect, the culminating age of classic art was contemporaneous with the first great development of mathematical science. In an earlier part of this discourse I have alluded to the importance of mathematical precision recognised in the technique of art during the Cinquecento; and I have now time only to add that on looking still further back‡ it would seem that sculpture and painting, architecture and music, nay even poetry itself, received a new, if not their first true, impulse at the period when geometric form appeared fresh chiselled by the hand of the mathematician, and when the first ideas of harmony and proportion rang joyously together in the morning tide of art.

Whether the views on which I have here insisted be in any way novel, or whether they be merely such as from habit or from inclination are usually kept out of sight, matters little. But whichever be the case, they may still furnish a solvent of that rigid aversion which both Literature and Art are too often inclined to maintain towards Science of all kinds. It is a very old story that, to know one another better, to dwell upon similarities rather than upon diversities, are the first stages towards a better understanding between two parties; but in few cases has it a truer application than in that here discussed. To recognise the common growth of scientific and other instincts until the time of harvest is not only conducive to a rich crop, but it is also a matter of prudence, lest in trying to root up weeds from among the wheat, we should at the same time root up that which is as valuable as wheat. When Pascal's father had shut the door of his son's study to mathematics, and closeted him with Latin and Greek, he found on his return that the walls were teeming with formulæ and figures, the more congenial product of the boy's mind. Fortunately for the boy, and fortunately also for Science, the mathematics were not torn up, but were suffered to grow together with other subjects. And all said and done, the lad was not the worse scholar or man of letters in the end. But, truth to tell, considering the severance which still subsists in education and during our early years between Literature and Science, we can hardly wonder if when thrown together in the afterwork of life they should meet as strangers; or if the severe garb, the curious implements, and the strange wares of the latter should seem little attractive when contrasted with the light companionship of the former. The day is yet young, and in the early dawn many things look weird and fantastic which in fuller light prove to be familiar and useful. The outcomings of Science, which at one time have been deemed to be but stumbling-blocks scattered in the way, may ultimately prove stepping stones which have been carefully laid to form a pathway over difficult places for the children of "sweetness and of light."

The instances on which we have dwelt are only a few out of many in which Mathematics may be found ruling and governing a variety of subjects. It is as the supreme result of all experience, the framework in which all the varied manifestations of Nature have been set, that our science has laid claim to be the arbiter of all knowledge. She does not indeed contribute elements of fact, which must be sought elsewhere; but she sifts and regulates

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* For example, in Herbart's "Psychologie."

† A specimen will be found in the "Moralia" of Gregory the Great, Lib. I., c. xiv., of which I quote only the arithmetical part:

"Quid in septenario numero, nisi summa perfectionis accipitur? Ut enim humanæ rationis causas de septenario numero taceamus, quas afferunt, quod idcirco perfectus sit, quia exprimo pari conatat, et primo, impari; ex primo, qui dividi potest, et primo, qui dividi non potest; certissimè scimus, quod septenarium numerum Scriptura Sacra pro perfectione ponere consuevit. . . . A septenario quippe numero in duodenarium surgitur. Nam septenarius suis in se partibus multiplicatus, ad duodenarium tenditur. Sive enim quatuor per tria, sive per quatuor tria ducantur, septem in duodecim vertuntur. . . . Jam superius dictum est quod in quinquagenario numero, qui septem hebdomadibus ac monade additâ impletur, requies designatur; denario autem numero summa perfectionis exprimetur."

‡ Approximate dates B.C. of—

Sculptors, Painters, and Poets.		Mathematicians.	
Stesichorus,	600.	Thales,	600.
Pindar,	522-442.	Pythagoras,	550.
Æschylus.	500-450.	Anaxagoras,	500-450.
Sophocles,	495-400.	Hippocrates,	460.
Euripides,	480-400.		
Phidias,	488-432.		
Praxiteles,	450-400.	Theætetus,	440.
Zeuxis,	400.	Archytas,	400.
Apelles,	350.		
Scopas,	350.	Euclid,	323-283.

them: she proclaims the laws to which they must conform if those elements are to issue in precise results. From the data of a problem she can infallibly extract all possible consequences, whether they be those first sought or others not anticipated; but she can introduce nothing which was not latent in the original statement. Mathematics cannot tell us whether there be or be not limits to time or space; but to her they are both of indefinite extent, and this in a sense which neither affirms nor denies that they are either infinite or finite. Mathematics cannot tell us whether matter be continuous or discrete in its structure; but to her it is indifferent whether it be one or the other, and her conclusions are independent of either particular hypothesis. Mathematics can tell us nothing of the origin of matter; of its creation or its annihilation she deals only with it in a state of existence; but within that state its modes of existence may vary from our most elementary conception to our most complex experience. Mathematics can tell us nothing beyond the problems which she specifically undertakes; she will carry them to their limit, but there she stops, and upon the great region beyond she is imperturbably silent.

Conterminous with space and coeval with time is the kingdom of Mathematics; within this range her dominion is supreme; otherwise than according to her order nothing can exist; in contradiction to her laws nothing takes place. On her mysterious scroll is to be found written for those who can read it that which has been, that which is, and that which is to come. Everything material which is the subject of knowledge has number, order, or position; and these are her first outlines for a sketch of the universe. If our more feeble hands cannot follow out the details, still her part has been drawn with an unerring pen, and her work cannot be gainsayed. So wide is the range of mathematical science, so indefinitely may it extend beyond our actual powers of manipulation, that at some moments we are inclined to fall down with even more than reverence before her majestic presence. But so strictly limited are her promises and powers, about so much that we might wish to know does she offer no information whatever, that at other moments we are fain to call her results but a vain thing, and to reject them as a stone when we had asked for bread. If one aspect of the subject encourages our hopes, so does the other tend to chasten our desires; and he is perhaps the wisest, and in the long run the happiest among his fellows, who has learnt not only this science, but also the larger lesson which it indirectly teaches, namely, to temper our aspirations to that which is possible, to moderate our desires to that which is attainable, to restrict our hopes to that of which accomplishment, if not immediately practicable, is at least distinctly within the range of conception. That which is at present beyond our ken may, at some period and in some manner as yet unknown to us, fall within our grasp; but our science teaches us, while ever yearning with Goethe for "Light, more light," to concentrate our attention upon that of which our powers are capable, and contentedly to leave for future experience the solution of problems to which we can at present say neither yea nor nay.

It is within the region thus indicated that knowledge in the true sense of the word is to be sought. Other modes of influence there are in society and in individual life, other forms of energy beside that of intellect. There is the potential energy of sympathy, the actual energy of work; there are the vicissitudes of life, the diversity of circumstance, health, and disease, and all the perplexing issues, whether for good or for evil, of impulse and of passion. But although the book of life cannot at present be read by the light of Science alone, nor the wayfarers be satisfied with the few loaves of knowledge now in our hands, yet it would be difficult to overstate the almost miraculous increase which may be produced by a liberal distribution of what we already have, and by a restriction of our cravings within the limits of possibility.

In proportion as method is better than impulse, deliberate purpose than erratic action, the clear glow of sunshine than irregular reflexion, and definite utterances than an uncertain sound; in proportion as knowledge is better than surmise, proof than opinion; in that proportion will the mathematician value a discrimination between the certain and the uncertain, and a just estimate of the issues which depend upon one motive power or the other. While on the one hand he accords to his neighbours full liberty to regard the unknown in whatever way they are led by the noblest powers that they possess, so on the other he claims an equal right to draw a clear line of demarcation between that which is a matter of knowledge and that which is at all events something else, and to treat the one category as fairly claiming our assent, the other as open to further evidence. And yet, when he sees around him those whose aspirations are so fair, whose impulses are so strong, whose receptive faculties so sensitive, as to give objective reality to what is often but a reflex from themselves, or a projected image of their own experience, he will be willing to admit that there are influences which he cannot as yet either fathom or measure, but whose operation he must recognise among the facts of our existence.

ADDRESS TO THE CHEMICAL SECTION

BY

Professor MAXWELL SIMPSON, M.D., F.R.S.,
President of the Section.

My position here is a highly honourable, but by no means a comfortable one. Naturally, you expect to hear from me something new about the Science which occupies the attention of this Section, and I have the miserable feeling that I must disappoint you. How can I possibly find a fact in Chemistry with which you are not already acquainted? If, in order to cater for you, I go to France, Germany, Russia, or America, I find the abstractors of the Chemical Society have been there before me, and have swept everything of value into their *Journal*. Chemists are now kept perfectly acquainted with the progress of Science in every part of the world, and therefore the *raison d'etre* of this Address, so far as announcing the discoveries of the year is concerned, has passed away. I therefore propose, instead of giving you a concentrated essence of the last twelve numbers of the *Journal of the Chemical Society*, to bring before you the claims of this Science to a place in general education, and the claims of original research to a place in the curriculum for higher degrees in our Universities.

I have been devoted to Chemistry all my life. It has been my business and my pleasure. The longer I live the more deeply am I impressed with the advantages to be derived from its study, and I am anxious that these advantages should be shared by the rising generation.

Whether we take into account the value of the knowledge acquired, the discipline of the intellectual faculties in acquiring that knowledge, or the effect on the character, surely we have a right to give the study of this Science a prominent place in our Schools and colleges. It would be difficult to over-estimate the value and extent of the knowledge we derive from Chemistry. Without it we can know nothing about the air we breathe, the water we drink, or the food we eat; we cannot understand the processes of combustion, respiration, fermentation, or putrefaction, or the endless chemical changes which are continually in operation around us, and which affect our lives for good or for evil. In a word, the whole of the phenomena of Nature must for ever remain to us, more or less, an inscrutable mystery.

Again, is it not desirable that we should have some acquaintance with the Chemical Arts, from which we derive so many of our comforts and luxuries? Should we not know something of the arts of photography, dyeing, me-

tallurgy—something of the manufacture of glass and china, and of the thousand beautiful things that are constantly in our hands? Not only is the knowledge we obtain from Chemistry very considerable in itself, but it furnishes us with a key which enables us to unlock vast stores of knowledge contained in several other sciences—these are, Physics, Geology, Mineralogy, Physiology, and I may now add, Astronomy. Physics and Chemistry are so intimately connected that it is difficult to say where the one begins and the other ends. The help that Chemistry gives to Physics is shown by the number of chemists who have distinguished themselves as physicists. I may mention a few belonging to our own time—Andrews, Bunsen, Faraday, Frankland, Graham, Guthrie, and Regnault.

With regard to mental discipline, the mind of the student is exercised in both the inductive and deductive methods of reasoning. His original faculties are stimulated by the consciousness that he can in many cases readily test the worth of his ideas by experiment. With inexpensive apparatus and a good balance, the intelligent student can make out for himself some of the laws and many of the facts of the Science, and it may be, also, add to them. He glides insensibly from the known to the unknown. Indeed, his spirit of inquiry demands, in most cases, to be curbed rather than spurred. Some students are constantly finding out new methods of analysis or discovering the precious metals in impossible places.

The readiness with which we can cross over into the *terra incognita* of Chemistry, and make little explorations there, constitutes in my opinion the great charm of this science, and, to a great extent, its value as an educational agent. What I wish to insist upon is, that the student of Chemistry can reach the field of original work sooner than the student of most other sciences. Once he commences original research, the development of his intellectual faculties rapidly progresses. His imagination is daily exercised in propounding new theories, and devising experiments in order to ascertain their truth or falsehood. And what more valuable intellectual training can there be than the habit of subjecting our ideas to the test of inexorable experiment? In the world outside Chemistry we are, alas! too ready to take things for granted. The chemist's motto is *prove all things*. The ancients adopted a different method: they assumed certain principles and reasoned from them. They therefore did little in science.

Chemistry promotes in a remarkable manner accuracy, thoroughness, and circumspection. An organic analysis requires six weighings: if any one of these is inaccurate, the results are worthless. A qualitative test carelessly applied may cause us, in a research, to waste months in the pursuit of a phantom or Will-o'-the-Wisp which can have no corporeal existence. If we have to employ absolute alcohol in our experiments, we must not be satisfied with going through the ceremony of making it absolute, but we must assure ourselves that it *is* absolute. Unless we are sure of every step in our research, our results become doubtful, and therefore of no value.

On the circumspection, also, of the original worker large demands are made. The avenues by which error may creep in and vitiate his results are very numerous. These he must foresee, and endeavour to close up. Laboratory work teaches us to use our senses aright, sharpens our powers of observation, and prevents us from reasoning rashly from appearances. It also promotes manual dexterity, and trains the hands to work in subordination to the head.

Perhaps in no other science is the student so deeply impressed with the order and economy of Nature, the immutability of her laws, and the exactness of her operations. These impressions will, no doubt, in after life impart seriousness to his character, and save him from the adoption of many a wild theory.

I come now to the effect of original work on the character. Many virtues are necessary to the chemist—courage, resolution, truthfulness, and patience. He is often obliged to perform experiments which are attended with great danger, and no man can hope to fight long with the elements without carrying away many a scar. Sometimes fatal accidents occur. Many years ago, Mr. Hennel, of the Apothecaries' Hall, London, lost his life by the explosion of a fulminating powder which he was preparing for the East India Company. And many of us recollect the sad death of young Mr. Chapman, a distinguished chemist whom I had the pleasure of knowing, who was literally blown to atoms while working in the Hartz Mountains on a new dynamite which he had himself discovered. I must tell the ladies, however, that accidents are not always so disastrous, but that often one may escape with merely the loss of an eye. But the chemist must not be discouraged by fear of accident, neither must he be disheartened by the temporary failure of his experiments, nor at the slowness of his processes. Bunsen was obliged to evaporate 44 tons of the waters of the Dürcheim springs in order to obtain 200 grains of his new metal, Cæsium. It took Berthelot several months to form, by a series of synthetical operations, an appreciable quantity of alcohol from water and carbon, derived from carbonate of baryta. Many years ago, in the laboratory of Wurtz—my honoured master—a poor student, whom I knew, was carrying from one room to another a glass globe, which contained the product of a month's continuous labour, when the bottom of the globe fell out, and the contents were lost. Nothing daunted, he re-commenced his month's work, and brought his research to a successful issue.

Above all things, the chemist must be *true*. He must not allow his wishes to bias his judgment or prevent him from seeing his researches in their true light. He must not be satisfied that his results appear true, but he must believe them to be true; and having faithfully performed his experiments, he must record them faithfully. He may often be obliged to chronicle his own failures and describe operations that tell against his own theories, but this hard test of his truthfulness he must not shrink from.

But I must not weary you with the virtues of the chemist. If I have succeeded in showing that the pursuit of this Science tends largely to develop the intellect and discipline the character, I think I have done something for Chemistry. We are told by Bishop Butler that "habits of virtue acquired by discipline are improvement in virtue, and improvement in virtue must be advancement in happiness."

I am glad to see that the importance of original research as a part of higher education is at last beginning to be recognised in this country. The Royal University Commission at Oxford has recently recommended that candidates for the higher degrees in science shall in that University be required in future to work out an original investigation. In Germany, where education has been so long and so well understood, original work has been, for at least the last half century, a *sine qua non* for a degree. Another admirable rule exists in that country, the adoption of which in Great Britain might go far to wash out the stain from our islands, of not having contributed our fair quota to the advancement of human knowledge. It is this—the Germans make a point of securing invariably that their scientific chairs shall be filled by men who have already distinguished themselves by their discoveries. The Professor, on his appointment, naturally desires to continue his investigations, and endeavours to secure, and usually succeeds in securing, the assistance of his pupils. This is a mutual advantage. The Professor is able to do more work for Science, and the student, on his part, learns to conduct for himself an original investigation. Hence there is always a rising generation of original workers in Germany, who turn out papers, more or less meritorious, with the rapidity of a Walter's press. They are stimulated by the hope of one day arriving themselves at a Professor's chair, the path to which they are well assured is only through the toilsome field of original work. But I must not wrong the German student by the implication of a purely selfish motive in his work. His labour is one of love, and his ambition, for the time at

east, is bounded by the desire to *do something* for science. And from a multitude of such enthusiasts the great Professors come. Great mountains are only found in mountainous countries.

I find myself insensibly led to speak of the encouragement of research in this country; and although it has been very largely discussed in scientific circles, I will venture to add a few words. To promote original work here, I believe it is indispensable that our Professors should be well paid. It would save them from the necessity of supplementing their incomes by commercial analyses, and thus enable them to devote their spare time to original work. And to secure that they shall have spare time, I would like to see in every laboratory a competent assistant, who would occasionally be able to take up the Professor's lectures should he be engaged in important work. There are many around me who know how very exacting original investigation is, and how necessary it is, at times, to be able to work on without interruption; bits and scraps of time being of no value. I am glad to see that the Oxford Commission also recommends the appointment of well-paid assistants. Well-paid Professorships and well-paid Assistantships would be attractive prizes for our students to work up to; and if it were clearly understood that the only way to these prizes was through original investigation, we should very soon have an army of zealous and competent workers.

The plan of appointing a staff of original workers unconnected with teaching has been proposed; but I do not approve of it. The original worker is, as a rule, the best teacher, and the rising generation of students should not be deprived of the advantage of his instruction. Moreover, as I said before, the Professor may be greatly assisted by his pupils.

No doubt the Government Grant Fund does a good deal for science, but the field of its operations is, under present conditions, limited. Professors, as a rule, are so occupied with teaching that they cannot avail themselves of the fund; and of those students who might be competent and willing, very few can afford to do so. Instead of trusting to the precarious and insufficient support of the fund, they must endeavour to settle themselves permanently in life.

It is much to be regretted that the Universities of Oxford and Cambridge, with such splendid revenues at their disposal, should contribute so little to the advancement of Physical Science. I hope the day is not far distant when the Fellowships—or at least a few of them—which now go to reward young men for merely passing a good examination, shall be given *without examination* to men who shall have advanced human knowledge in any department. At present a Fellowship of £250 or £300 a-year, lasting ten or twelve years, and in some cases for life, may be obtained on showing proof of a good memory—or, at most, a capacity for assimilating other men's ideas. To make discoveries—to follow out a new train of thought, and establish it by experiments specially devised to that end—has been left not only without reward, but almost without recognition, in our two principal seats of learning. Is it to be so always? The world at large, ignorant as it is, has a sounder instinct on this subject, and the man who makes the humblest addition to the stock of knowledge in the world rarely fails to receive the world's respect and honour.

The suggestions I have ventured to make could not, of course, be well carried out, unless the Government take into its own hands the appointment to all Scientific Chairs. Of this I think I see indications. I believe that sooner or later the Government will assume the supreme direction of education in this country. It has already taken Primary Education under its control, and quite recently, here in Ireland, Intermediate Education to a great extent. And does the appointment of so many University Commissions not show a disposition on the part of the Government to assume the direction of Higher Education also?

NOTES FROM THE PARIS EXHIBITION.

A METHOD OF ECONOMICAL EVAPORATION.

AMONGST the many curious and interesting machines exhibited at the Paris Exhibition of 1878, one for the cheap evaporation of salt solutions is well worthy of notice. It serves for the separation of salt from water in places where fuel is difficult to be obtained, and better still where there is a waterfall.

It is well known that to raise the temperature of water from 0° to 100° C. it is necessary to use up 100 calorific units for each litre; and further, to transform this water at 100° into steam at 100°, 530 more units have to be expended, so that altogether 630 units will have been used. The first 100 units give specific heat to the water, the other 530 give latent heat to the steam. Now nearly all this heat, which is produced by a large consumption of fuel, escapes in the steam; but if by some contrivance the ultimate result came out as cold water which had left its heat in the apparatus, there would be no further need of a fire to carry on the evaporation, and thus a great item of expense—viz., of fuel—would be saved.

Now an apparatus to do this work must be hermetically closed, so that no air can get mixed with the steam inside; and also, although closed, it must be so constructed that the precipitated salt can be withdrawn regularly. Admitting that these conditions could be fulfilled, let us see how the heat of the steam could be utilised.

If the steam is taken by means of a pipe to the water which is to be evaporated, the steam will be condensed if the water is colder than the steam, and the latent heat of the steam—viz., 530 calorific units—will be transferred to the water. There are two ways in which this can be accomplished:—First, when there is an hydraulic force at hand, the steam formed in the boiler is compressed by means of a pump; this raises its temperature; it then suffices to pass it back into the boiler in which it has been produced, to condense it entirely: thus the latent heat absorbed by the steam in forming is made to pass back into the salt water. Secondly, when there is not an hydraulic force at hand, the temperature of the steam cannot be raised by compression; but it is made to pass into a second boiler a little colder than the first, where it is condensed; then the steam from the second is made to pass into a third, still colder, and so it is continued. This latter method has been employed for some time in distilleries and sugar-factories,—therefore it is needless to enlarge upon it here.

I now come to the description of the apparatus, a general view of which is here given. The salt water on arriving passes through a wooden tank, A, furnished with tubes inside; it then enters the principal boiler, B, where it is partly heated by the steam there; then it goes into a second boiler, C, where it is heated under pressure: from there it returns to B, where, the pressure being taken off, causes some of the water to turn into steam by means of the extra heat it gives out. From B the steam passes to the pump, where it is compressed; then back again to C, which is furnished with tubes inside like A; but in this instance the steam passes through the tubes instead of, like the water, going through the tank itself. After having traversed all the tubes in C it is carried along back to A, where it passes through the tubes, and at last escapes from A in the state of cold water. Let us now return to the principal boiler, B. It is a long cylinder, having several tubes connecting it with other parts of the apparatus. At one end it is joined to C by means of a small iron cylinder, which is fitted with valves worked so as to keep the water in C under slight pressure, and therefore a little lower than in B. At the opposite side of C there is another tube which conducts the water into B again, where, as before mentioned, it is turned into steam; thus there is a constant stream flowing between B and C. At the bottom of B there is a long curved tube, shaped something like the letter J, which is

Influence of Strong Nitrogenous Manures upon the Development of Barley.—Dr. W. Hoffmeister.—The author concludes that manuring with nitrogenous salts increases the absolute weight of the barley, both green and dry. Ammoniacal salts are more effective than nitrates, and act most advantageously when dissolved in small portions, and given frequently. They delay, however, though slightly, the ripening of the crop. The relative percentage of ash remains constant, and is only effected by the periods of vegetation, possibly by the weather, but not by manuring. The absolute amount of nitrogen is greatly increased by manuring with ammoniacal salts, but much less by nitrates.

Influence of Varying Intensity of Light on the Growth of the Vine.—Prof. J. Macagno.—The decrease of the intensity of light hinders the formation of sugar; the formation of the other products of assimilation is directly proportionate to the intensity of the light.

Phosphoric Acid in Wines.—Dr. R. Kayser.—Phosphoric acid in combination is present in all natural wines. In 100 c.c. the quantity varies from 0·058 grm. in Malaga, 0·037 in Pedro Ximenes, and 0·028 in select Tokay, down to 0·005 in claret, 0·004 in a petit vin from the Rhone, and 0·003 in a red wine from the south of France.

Attempts to Neutralise Sour Wines.—F. Kurmann.—The author is of opinion that where small quantities only of acetic acid have been formed, the addition of sodium or potassium carbonate is not to be condemned. But the evil is by no means removed, and the acetification is very likely to continue.

Spurious Colouration of Wines.—W. Bachmeyer.—The author has observed that all the known colouring matters used in the sophistication of wines, such as alizarin, magenta, madder, mallows, bilberries, carrots, peach wood, cochineal, extract of indigo, if added to white wine, are more readily destroyed by nitric acid of spec. grav. 1·2 than the genuine colour of wine. Five c.c. of the suspected wine are mixed with an equal volume of the acid, stirred up with a glass rod and let stand. If the wine is spurious the colour will disappear within an hour, often in a few minutes; whilst, if genuine, it remains for days.

"Turning" of Red Wines.—A. Schultz.—Clear, sound wines sometimes become dull, and assume a faint and ultimately acid flavour. Gas is then evolved, and the red colour of the wine passes into a reddish brown. This change is due to a decomposition of the tartar, which is attacked by a ferment, which has been examined by Pasteur.

Chemical Investigation on the Action of Wine upon the Common Metals.—L. A. Magnien.—The action of wine upon the metals with which it is liable to come in contact has been little studied. The author finds that if the quantity of cast-iron dissolved by wine = 100, that of wrought-iron in an equal time is 97·87, zinc 92·07, lead, 6·26, tinned iron 2·90, tin 1·59, bronze 0·72, copper 0·46, and brass 0·28.

Heft 4, 1878.

Determination of the Proportion of Ammonia in the Air and in Atmospheric Waters.—A. Levy and M. Allaire.—From the *Comptes Rendus*.

Conduction of Heat in Dry and Moist Soils.—Prof. F. Haberlandt.—The author's conclusions are that the heat conductibility is greater in moist earth than in dry. The effect of the greater conductibility at higher air temperatures is concealed by the greater evaporation from moist soils, the difference in temperature between moist and dry soils to the disadvantage of the latter being so much the greater the more heat is lost by evaporation, *i.e.*, the higher the temperature of the air. At low atmospheric temperatures (+1° to +8°) the better conductibility of the moist soil comes into play. The limit of temperature at which the action of the increased heat conduction equals the effect of the continuous cooling by evaporation is not alike for all kinds of soil. It is highest in sandy soils and lowest in moor soil. The differences of temperature between dry and wet soil are very trifling (up to 1·5°), and a wet soil can therefore scarcely be characterised as cold.

Evaporation of Water from the Soil.—Prof. F. Haberlandt.—The evaporation increases with the proportion of water in the soil and is also very much increased by increased atmospheric heat, even in the absence of direct solar irradiation. Sand and arable soils, even after small additions of water, lose more by evaporation than an open water-surface. The behaviour of moor-soil is different. The quantity of water near the surface evaporates rapidly, and the process becomes slower with increasing depth.

Influence of Potassic Manures upon the Vine.—Prof. A. Andoynaud.—Sulphate of potash and chloride of potassium have a marked influence upon the growth of the vine. Nitrate of potash, however, is far preferable, and the carbonate inferior in its efficacy. Weak vines seem to require as much manure as strong ones. An excess of nitrogenous matter is rather injurious than beneficial. Potash must enter into the composition of vine-manures, as that in the soil is generally in a state not well adapted for assimilation.

Synthesis of Albuminoids in the Animal Organism.—M. Rudzki and Dr. E. Oertmann.—Rudzki draws from his observations the general conclusion that the organism effects the synthesis of albuminoids from the carbohydrates and extractive matters or uric acid. He considers the albuminoids as amides or nitriles of the carbohydrates, and supposes that the synthesis is effected by the liver. Oertmann having undertaken a careful re-investigation of the question finds that the nutritive value of an insufficient diet is not increased by uric acid.

What Influences Determine the Sex of Hemp Plants?—Prof. F. Haberlandt.—The supposition that it is possible by external influences to determine a preponderating development of male or of female individuals is unfounded. In the case of hemp plants the number of females almost invariably exceeds that of males, not probably because originally a greater number of female germs are developed, but because a greater mortality takes place among the male plants. Male plants, like male insects (and unlike male mammalia), attain maturity earlier than the respective females. The sex of the future hemp plants is præ-determined in the seed.

Recent Communications on Insects Destructive to Plants, and on their Extirpation.—Dr. N. Dimitriewiaz, Dr. A. Sempolowski, Leo Pribyl, &c.—An account of various insects noxious to crops, and of the means proposed for their destruction.

Remarks on the Inversion of Saccharose During the Process of Refining.—Prof. J. W. Gunning and L. Serrurier.—In opposition to Girard, Gunning maintains that a portion of cane-sugar is reduced, not by the presence of reductive sugar, but by free acids.

Adulteration and Examination of Beer.—Prof. Reichardt, Prof. Holzner, Dr. Hager, and R. Hofstedt.—For the detection of incipient acidity the taste of an experienced judge and microscopic examination are preferable to the alkalimetric determination of free acid, or the distillation of volatile acids. In the first place titration is difficult in a coloured liquid like beer, whilst the complete removal of free acid by distillation is difficult. The microscope shows very distinctly the changes which the yeast granules have undergone as soon as a tendency to acidification is perceptible. Bottom-yeast consists of top-yeast mixed with more oval particles, but when the beer turns sour these are interspersed with a greater or less number of longish granules, whilst in decidedly sour beer long branching threads are present resembling the

lactic acid ferment. In normal beer glycerin is found only in small proportions, 0·27 to 0·28 per cent. Buxin, the bitter alkaloid of the common box-tree, has been detected in beer by Hager. Hofstedt has detected a case where absynthin was introduced into beer by means of hops adulterated with the extract of wormwood.

Preservation of Wine by the Addition of Aluminium Phosphate.—Bogdan Hoff.—The author added to twelve bottles of turbid wine respectively a variety of substances, among which was aluminium phosphate to the extent of 1½ to 1 per cent. The bottles were then allowed to stand open from December 15 to April 14. The bottles containing this addition remained perfectly good, and tasted older by six years. The others were either covered with mould or had passed into the acetic fermentation. In the wine treated with phosphate of alumina the acidity had diminished.

On Testing Milk.—Prof. A. Kaiser and Prof. E. Schulze.—The untrustworthy character of the indications afforded by the "cremometer" is pointed out. They place the greatest reliance upon the "stall-proof." If the seller of a suspicious milk maintains that it is normal, the cows are milked the next day by persons in the employment of the authorities, and the sample thus obtained is compared with the one seized. (This method would be of course utterly inapplicable in England, where much of the milk sold could not be traced back to the animals from which it has been obtained.)

Gazzetta Chimica Italiana.
Fasc. iv., 1878.

Electrolytic Determination of Zinc, Lead, Antimony, and Iron in their Ores and in Artificial Products.—G. Parodi and A. Mascazzini.—Reserved for more extended insertion.

Prismatic Sulphur from the Alcoholic Solution of Ammonium Sulphide.—The cause determining the crystalline form of sulphur is not fusion or solution; not the quality of the solvent, but the temperature at which the crystals are formed.

A Lecture Experiment.—T. Brugnatelli.—Into a two-litre bottle, half full of cold water and saturated with carbonic acid, is put ether, enough to form a stratum of a centimetre in depth. The bottle is closed with a caoutchouc stopper and violently agitated. When the space filled with compressed gas becomes transparent and the liquid tranquil the stopper is opened, when suddenly there is produced a dense cloud, and the sides of the bottle are covered with a copious dew. The cloud and the liquid are the proof of the fall of temperature.

Certain Derivatives of Tetrachloric Ether.—E. Paterno.—A claim of priority in reference to a paper by J. Busch inserted in the *Berichte der Deutsch. Chem. Gesell.*, v., p. 415.

New Researches on the Aldehydic Derivatives of the Organic Bases and of Urea.—Ugo Schiff.—Not capable of useful abstraction.

Fasc. v., 1878.

Identity of the Usnic and Carbonusnic Acids.—E. Paterno.—The author concludes that the acid extracted by Hessee from *Usnea barbata* (Hoffmann) and that obtained by Salkowski from *Usnea barbata* (Fries.), *florida* (Hoffmann) are usnic acid identical with that which he has studied and extracted from *Zeora sordida*. Usnic acid, $C_{18}H_{16}O_7$, is an anhydride, and its monometallic salts correspond to the formula $C_{18}H_{17}MO_8$.

Preparation of the Oxychloride of Carbon.—E. Paterno.—The author passes the mixture of chlorine and carbonic oxide through a glass tube of about 15 m.m. in diameter and 40 centimetres in length, filled with fragments of animal charcoal. In presence of this substance the combination of the two gases takes place with great rapidity and without the need of the action of solar light. It is accompanied with a considerable evolution of heat, which makes it necessary to cool the tube with flax soaked in cold water, which is renewed from time to time.

Process for Detecting Nitric Acid in the Lemon Juice of Commerce.—F. D. Scribani.—To detect nitric acid in crude lemon juice it is sufficient to pour a small quantity into a test-tube, adding ferrous chloride in aqueous solution, strongly acidulated with hydrochloric acid, boiling the liquid for a few minutes, and testing the solution with an aqueous solution of potassium sulphocyanide. If the juice in question contains nitric acid the liquid will take a blood-red colour, more or less intense according to the proportion.

Chemical Researches on the Minerals and Rocks of the Island of Vulcano.—Prof. Alfonso Cossa.—In this first section of what promises to be a bulky memoir the author treats of potash-alum, containing alums of thallium, rubidium, and cæsium.

Carbothialdin and other Sulphuretted Compounds.—Prof. Icilio Guareschi.—Not suitable for abstraction.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 11, July 11, 1878.

Discovery of a Third Acid in the Reaction of Sugar and Potassium Permanganate.—M. Maumené.—Diehic acid, $C_4H_4O_8$, is easier to obtain, especially as a neutral potassic salt, than the two others, the discovery of which has been previously announced by the author, hexipic acid, $C_{12}H_{12}O_{16}$, and triejic, $C_6H_6O_{10}$. The diehate of potassa is perfectly crystalline, forming large and well-defined prisms. The solution scarcely precipitates any metallic solution, not even neutral plumbic salts; it reduces the solutions of gold and silver, forming double salts. The discovery of this new acid completes the study of the reaction of sugar with permanganate, no other product than the following being possible.

1. Hexipic acid.
2. Triejic ,,
3. Diehic ,,
4. Oxalic ,,
5. Carbonic ,,

Certain Consequences of the Constitution of the Solar Spectrum.—M. A. Cornu.—The author speculates on the probability of direct magnetic action upon the sun, of an internal terrestrial magnet, and of the electric origin of the light emitted by the solar protuberances.

Scientific Instruments at the Paris Exhibition.—A copiously illustrated description of scientific instruments, most of them exhibited by MM. Ducretet.

Chemiker Zeitung.
No. 30, July 25, 1878.

Prof. Liebreich recommends hydrogen peroxide for the preservation of milk.

Among the papers to be read at the Congress of German Naturalists and Physicians, which will be held at Cassell from the 18th to the 24th of September, may be mentioned—"On Colour-sense and Colour-blindness," by Dr. Stilling; "On the Relation of Darwinism to Social Democracy," by Prof. Oscar Schmidt; "On William Harvey's Life and Activity," by Dr. Baas, of Worms.

The pollution of rivers in the Kingdom of Saxony has been investigated. The textile manufactures are debited with 49 per cent of the contamination; the leather trades with 16; mines with 8; the production of illuminating agents with 4. In the districts of Dresden and Bautzen there are complaints concerning the waste-waters from flax-steeping.

A brewer of Lindau, who had obtained from a Berlin a hectolitre cask of glycerin and 1 kilo. of salicylic acid, and introduced them into his beer, was condemned to twenty-one days imprisonment for fraud and to a penalty of 4000 marks (£200) for an evasion of the malt-tax. The vendors of the chemicals were fined £5 in each case.

MISCELLANEOUS.

Society of Public Analysts.—The next General Meeting of this Society will be held at Dublin on Monday, the 19th instant, at 3 p.m., at the Royal College of Surgeons, Stephen's Green. The following Papers will be read:—"On the Inconstant Composition of Well Waters," by C. A. Cameron, M.D.; "On the Solubility of Plumbic Iodate," by C. A. Cameron, M.D.; "Notes upon the Desirability of Fixing by Analysis some Standards of Value for Beer based upon the Qualities usually sold in Large Towns," by C. Estcourt, F.C.S.; On the Nitrogen Compounds present in the Cereals" (third paper), by G. W. Wigner, F.C.S.; "On the Distinctive Tests for Carbolic Acid, Cresylic Acid, and Creosote," by A. H. Allen, F.C.S.

NATURE for August 15 contains:—

The Coming Eclipse. By J. Norman Lockyer, F.R.S.
Our Natural History Collections.

The British Association:—
Inaugural Address of William Spottiswoode, M.A., F.R.S., LL.D., D.C.L., President.
Section C.—Geology.—Opening Address by the President, John Evans, D.C.L., F.R.S., F.G.S., &c.
Section D.—Biology.—Opening Address in the Department of Zoology and Botany, by Prof. W. H. Flower, F.R.S., President of the Section.

Notes of the Week.
The Norwegian North Atlantic Expedition. By Dr. H. Mohn.
The Eclipse of the Sun.
Our Astronomical Column.
Letters to the Editor:—A New Mineral—Prof. N. S. Maskelyne, F.R.S. The Colouring of Birds' Eggs—H. C. Sorby, F.R.S. The Limbs—Prof. G. M. Humphry, F.R.S. The Darkness of Caverns—Prof. Salvador Calderon. Scent and Colour in Flowers—G. S. Boulger.

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Prospectuses of the several Departments may be obtained from Mr. Cornish, Piccadilly, and other Booksellers in Manchester, and at the College.
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Experimental Physics, Organic Chemistry, Theoretical Chemistry	Prof. C. NEUBAUER, Ph.D.
Chemical Technology	H. FRESENIUS, Ph.D.
Botany, Zoology	Prof. L. KIRSCHBAUM, Ph.D.
Mineralogy	F. HENRICH.
Microscopy, with exercises in microscopic work	H. THIELENIUS, M.D.
Practical Instruction in the Laboratory	Prof. R. FRESENIUS, Ph.D., H. FRESENIUS, Ph.D., and two Assistants.

The next Session commences on the 15th of October. The Regulations of the Laboratory and the Syllabus of Lectures will be forwarded gratis on application to C. W. KREIDEL'S Verlag, at Wiesbaden, or to the undersigned.
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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 978.

ON THE

AMOUNTS OF SUGAR CONTAINED IN THE NECTAR OF VARIOUS FLOWERS.*

By ALEX. S. WILSON, M.A., B.Sc.,
Fellow in Natural Science, Glasgow University.

NECTAR is the term applied by botanists to the sweet-tasted fluid which is secreted within the cups of insect-fertilised flowers; and the object gained to the plant by its presence is that insects, induced to visit flowers for its sake, are useful to the plants by effecting a cross-fertilisation. Mr. Darwin has shown what an amount of additional vigour is thus conferred on the seeds which subsequently result in contrast with the evil effects produced by continuous inbreeding. In many instances this sweet liquid is exuded from special glands, but in other cases from portions of the flower that do not seem to have been specially adapted for this purpose. Morphologically, nectaries may represent very different structures, but not unfrequently they are of the nature of an aborted organ—such as a petal or stamen. It is a point in dispute among biologists whether this saccharine matter is a true secretion or simply an excretion of effete matter from the vegetable cells—a by-product of the chemical changes taking place within these cells. The latter view seems to be favoured by the fact that a similar sweet-tasted fluid, much sought after by insects, is exuded on different parts of some plants quite unconnected with the flower, as in the laurel, brake fern, lime tree, acacia, &c. As to the use of such exudation of sweet fluid, various suggestions have been made by those who are disposed to regard it as a true secretion; as, for instance, that it serves as an attraction to certain insects to frequent the plant, these insects rendering service by keeping off animals to whose attacks the plant may be subject. Probably this is to some extent true, but it cannot be said to hold universally. Nectar is of course the source whence the bee derives honey, but it also affords food to many kinds of insects which do not possess the habit of storing up. A division of the humming birds is named Melliphagi on account of living on this substance; but it is probable that in some cases the small insects seeking the nectar, and not the nectar itself, may be the object of the visits of these birds to nectar-producing flowers. The bright colours, as shown by Sir John Lubbock's experiments, serve to guide insects to the flowers, and the odours which they emit fulfil the same end. The markings on a flower's petals, it is to be noted, always converge towards the nectar, as in the violet. The importance of these guides to insects will be apparent from the following estimations, which show how indispensable it is that as little time as possible should be lost by an insect collecting honey. It must also be remembered that the nectar is usually contained in the most secure and best covered part of the flower, the object being to prevent the access of rain, which, owing to the extreme solubility and diffusibility of sugar, would speedily cause it to be transferred to parts of the plants where insects could reach it without being of any service in the way of cross-fertilisation. The chief purpose of the flower would in this way be frustated. The formation of nectar is observed to take place most freely in hot weather, and to be prevented by cold or wet. So great economy is exercised by the plant that it is only formed at the time when insects' visits would be beneficial, *i.e.*, when the anthers are ripe and shedding their pollen, or when the stigma is mature and ready to receive pollen. By biologists the visits of bees, butterflies, and other insects are believed to have exercised in past time an important influence in modifying the size, shape, colour, &c., of flowers, and the following experiments, in spite of their incompleteness, are of interest as showing to what an extent this action takes place in nature, and as helping to determine the value of this factor. These estimations are only the first of a series, and the writer regrets that he has been unable to give them the desirable completeness, but hopes to continue them.

The nectar was extracted with water, and the sugar determined before and after inversion by means of Fehling's copper solution. Many of the estimations were done in duplicate, and gave results that agreed perfectly. In the case of fuchsia—which is not deprived of its nectar by any insects in this country, the nectary being inaccessible to native species—we have probably the whole amount formed, but in the other cases the visits of bees, &c., may have reduced the amounts considerably. In this case it is a clear colourless liquid, having an acid reaction and an intensely sweet taste; that of many others has the strong characteristic odour of honey:—

Sugar in Flowers.

	Total. M.m.g.	Fruit.	Cane? (as Fruit.)
1. Fuchsia, per flower ..	7·59	1·69	5·9
2. *Claytonia Alsinoides*, do.	0·413	0·175	0·238
3. Everlasting pea, ditto..	9·93	8·33	1·60
4. Vetch (*Vicia Cracca*) per raceme	3·16	3·15	0·01
5. Ditto, per single flower	0·158	0·158	—
6. Red clover, per head ..	7·93	5·95	1·98
7. Ditto, per floret	0·132	0·099	0·033
8. Monkshead, per flower	6·41	4·63	1·78

Approximately, then, 100 heads of clover yield 0·8 grm. sugar, or 125 give 1 grm., or 125,000 1 kilo. of sugar; and as each head contains about 60 florets (125,000 × 60), that is, 7,500,000 distinct flower tubes must be sucked in order to obtain 1 kilo. sugar. Now as honey, roughly, may be said to contain 75 per cent sugar, we have 1 kilo. grm. equivalent to 5,600,000 flowers in round numbers, or, say, two and a half millions of visits for one pound of honey. This shows what an amazing amount of labour the bees must perform, for their industry would thus appear to be indispensable to their very existence. Another point worth notice in these results is the occurrence of what appears to be cane-sugar, and that in the case of fuchsia in the proportion of nearly three-fourths of the whole. This is remarkable, as honey is usually supposed to contain no cane-sugar, its presence being usually regarded as certain evidence of adulteration. The question therefore arises whether this change, which takes place while the sugar is in the possession of the bee, is due to the action of juices with which it comes in contact while in the honey-bag or expanded œsophagus of the insect, or whether the process of inversion goes on spontaneously, as may perhaps be the case.

* Read before the Chemical Section of the British Association, Dublin, 1878.

ON A SIMPLIFICATION IN GRAPHIC FORMULÆ.*

By OLIVER LODGE, D.Sc.

IN a graphic formula the atoms of a compound are ordinarily represented by its chemical symbol (a capital letter), and the connections between the atoms are represented

* Abstract of a Paper read before the Chemical Section of the British Association. Dublin, 1878.

by straight lines joining the letters. Now graphic formulæ are of most use in organic chemistry where the principal compounds consist only of the elements C, H, O, N, whose atomicities are 4, 1, 2, and 3 or 5 respectively. In any formula, therefore, 4 bonds always radiate from the letter C; N is the meeting-place of 3 or 5 bonds, according to circumstances; 2 bonds meet at each O; and a single bond terminates at every H. Suppose now that the letters were omitted and the bonds joined up together, the position of the atoms would still be apparent as the meeting-place of a definite number of bonds; and therefore the letters are unnecessary.

The simplification I propose, then, is the omission of the usual symbols used to denote the atoms, and the joining of the bonds in such a way as clearly to define the atomicities (and therefore the natures of the several atoms. [Formulæ so drawn become reduced to a sort of geometrical diagram; and conversely, any geometrical curve represents some real or imaginary chemical compound.]

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

No. VII.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(1.) *On Silver Arsenite Insoluble in Aqueous Ammonia.*

By J. R. SANTOS, of Guayaquil, Ecuador.

In the text-books it is usually stated that the light yellow precipitate of silver arsenite is soluble in excess of ammonia. Thus, Fresenius says* that a yellow precipitate of tribasic silver arsenite is produced when a solution of a neutral arsenite is decomposed by silver nitrate:—"The precipitate dissolves easily in nitric acid, as also in ammonia; it is also not insoluble in ammonium nitrate." Classen† says of an aqueous solution of arsenious acid, "silver nitrate, after neutralisation of the free acid with a little ammonia, throws down light yellow silver arsenite, soluble in ammonia, nitric acid, and ammonium nitrate." Watts‡ says—"Nitrate of silver added to aqueous arsenious acid produces a scarcely appreciable yellow turbidity, and on cautiously adding ammonia, a canary-yellow precipitate of arsenate of silver, which dissolves with great facility in nitric acid, acetic acid, and excess of ammonia." Odling‖ says—"Ammonio-nitrate of silver, added to aqueous arsenious acid, throws down an opaque yellow precipitate of arsenite of silver, soluble in ammonia and in dilute nitric acid." Gmelin§ says silver arsenite "is insoluble in water, but dissolves in acids—in nitric acid, for instance—and when recently precipitated, also in ammonia (Marcet). It dissolves in acetic acid more readily than the phosphate of silver oxide (H. Rose)." In Bloxam's paper¶ on the arsenites, the composition of silver arsenite is examined, but there is no mention of its solubility.

Having noticed that the yellow precipitate obtained by mixing solutions of silver nitrate and sodium arsenite, if washed several times by decantation, did not dissolve (at any rate completely) in aqueous ammonia, but assumed a well-marked crystalline character, and a darker yellow colour, I proposed to Mr. Santos to analyse this crystalline residue, and to examine the general question of the relation of the original precipitate to ammonia. His results were as follows:—

Solution of sodium arsenite (obtained by boiling sodium carbonate solution with excess of arsenious oxide) was added to solution of silver nitrate, the yellow precipitate was thoroughly washed with water, and strong solution of ammonia added. A part of the precipitate dissolved, and a part remained, the latter deepening in colour, and tending to become crystalline. The greater the relative amount of silver nitrate used the larger the proportion of the precipitate which remained undissolved, while using more of the arsenite, a larger proportion was taken up by the ammonia. Owing to the readiness with which the yellow crystalline residue darkens on exposure to light, it could not be dried and weighed in an unchanged state. It was therefore carefully washed, proved to be free from ammonia; and an undetermined amount of it (still moist) having been digested with nitric acid, the silver was thrown down as chloride, and the arsenic as ammonio-magnesian arseniate. 2·3221 grms. of silver were obtained for 0·4989 grm. of arsenic, showing that the salt was probably normal tribasic silver arsenite, although there was a little silver in excess of this, the ratio Ag : As being 2150 : 665, or 3·23 : 1. A solution of sodium arsenite was mixed with one of silver nitrate in the proportion of 1 atom of arsenic to 3 atoms silver, with a little nitric acid, just enough to prevent precipitation, and then sodium carbonate added in excess. The same bright yellow precipitate as above was formed, tending to become crystalline when thrown down slowly. The filtrate from this precipitate was free from silver, and contained but a trace of arsenic; hence the salt thrown down was the tribasic arsenite. The precipitate itself was quite free from silver carbonate: it turned dark with great rapidity, even in dim diffuse light; was only partially soluble in aqueous ammonia by itself, but dissolved readily in the same when containing alkaline nitrates, and was but slightly dissolved by cold acetic acid. When this experiment was repeated, using 2 molecules or 1 molecule of silver nitrate in place of 3, the precipitate obtained dissolved readily in ammonia free from alkaline nitrates, and in cold acetic acid. The same crystalline yellow salt, but gradually and imperfectly dissolved by pure aqueous ammonia, was also produced by mixing solutions of sodium arsenite (1 atom arsenic) and silver nitrate (3 mols.), containing free nitric acid enough to prevent immediate precipitation, and then adding sodium acetate in excess.

Hence it appears that the normal tribasic arsenate of silver is not as such soluble in ammonia, but becomes readily soluble by the presence at the same time of alkaline nitrates; that it is slowly and imperfectly decomposed by the continued action of ammonia, forming perhaps an argent-ammonium salt; and that a silver arsenite containing in combination or admixture a larger proportion of arsenic than that of the tribasic salt is at once soluble in ammonia by itself; a corresponding difference of solubility in acetic acid being under these conditions observable in each case.

(2.) *Analysis of Lamp-black made from the Natural Hydrocarbon Gas of the Ohio Petroleum Region.*

By J. R. SANTOS.

This material is described in the following passage from my portion of the "Report of the Judges on the Philadelphia Exhibition of 1876" (Group III., Chemical Manufactures):—"One of the more interesting among the minor American exhibits consisted of the fine lamp-black which has for about two years past been made at Gambier, Ohio, by imperfect combustion of the natural gas which occurs throughout the petroleum region, and which frequently escapes in such quantity from borings, yielding little or no mineral oil, as to give rise to the term 'gas-well.' There are two such wells in Knox County, Ohio, near the junction of the Kokosing and Mohican Rivers, affording very large quantities of hydrocarbon gas, which Mr. Peter Neff, of Gambier, has utilised in the manufac-

* *Anleit. zur Qualit. Chem. Analyse*, 11 Aufl., S. 155.
† *Grundr. der Analyt. Chemie.*, 1 Th., S. 27.
‡ "Dictionary of Chemistry," vol. i., p. 361.
‖ "Practical Chemistry for Medical Students," 3rd ed., p. 158.
§ "Handbook of Chemistry" (Cavendish Society's Trans), vol. vi., p. 187.
¶ *Journal of the Chemical Society*, July, 1862, p. 290.

ture of lamp-black, which he calls 'Diamond Black.' He has patented and uses several kinds of apparatus for burning the gas [of which two are described and figured in the Report]. In the building used, 1800 burners are at work, consuming about 275,000 cubic feet of gas per twenty-four hours, being about one-fourth of the available supply. The composition of the gas by volume is given as—

Marsh gas	81·4
Ethyl hydride	12·2
Nitrogen	4·8
Oxygen	0·8
Carbon monoxide	0·5
Carbon dioxide	0·3
	100·0

"No mention is made of free hydrogen, though from the experiments of Prof. Sadtler on samples of natural gas from Western Pennsylvania, it probably is present in small quantity. The lamp-black is at present manufactured to the extent of about 16 tons per annum. It is very fine and smooth, free from coarse or gritty particles, and of an intense blue-black colour. The absence of oily matter is very strikingly shown by mixing it with water. Although from the large amount of air in the mass of loose powder most of it floats at first upon the surface, stirring soon mixes it in large quantity with the water, rendering the whole black and opaque: in this behaviour it contrasts strongly with common lamp-black. It does not colour ether, and the liquid, when evaporated, leaves but a trace of residue, while ordinary lamp-black, presumably from rosin, gives a deep yellow solution, leaving an orange-brown tar on evaporation. On burning a quantity of the diamond-black sufficient to fill a large platinum dish, a barely visible trace of ferruginous ash was left, derived, no doubt, from the scraping of the metallic surfaces (on which the material was deposited and collected). This material is sold to makers of fine printing and lithographic ink in the United States, and has been sent in small quantity to Europe. It deserves to become more widely known."

I have used this lamp-black for a number of laboratory purposes requiring an artificial form of carbon of very high degree of purity. Mr. Santos has analysed it, with the following results:—

Sp. gr. at 17° C., after complete expulsion of air, equals 1·729. The air-dried lamp-black lost by exposure at ordinary temperature over sulphuric acid 2·30 per cent of moisture, and a further loss of 0·40 per cent was experienced by heating to 100° C. Continued heating to 200° and then to 300° under atmospheric pressure gave rise to no further loss, but a minute amount of water was expelled by subsequently heating in a Sprengel vacuum.

The material dried at 200° C. gave in two combustions—

	I.	II.
Carbon	96·041	96·011
Hydrogen	0·736	0·747

The occluded gases, driven out by heating to low redness in a Sprengel vacuum,* represented, on calculating weight from volume,—

Carbon monoxide	1·378 p.c. by weight
Carbon dioxide	1·386 „ „
Nitrogen	0·776 „ „
Vapour of water	0·682 „ „

There was also expelled, and condensed on the cooler part of the tube, 0·024 of a solid light yellow hydrocarbon, soluble in alcohol, fusible, and volatilising rapidly under atmospheric pressure between 215° and 225° C. (impure naphthalene ?)

Hence the composition of the lamp-black may be calculated as—

Carbon	95·057 *
Hydrogen	0·665 *
Nitrogen	0·776
Carbon monoxide	1·378 †
Carbon dioxide	1·386 †
Water	0·682
Ash (Fe_2O_3 and CuO)	0·056
	100·000

(3.) *Examination of the Products of Weathering of Allanite.* By J. R. SANTOS.

The allanite found in large quantity in Amherst Co., Virginia,‡ presents itself for the most part in detached lumps, from a few ounces to three or four pounds in weight, showing rough crystalline faces as well as fractured surfaces, and often coated with a crust (the result of weathering), varying from a mere film to a fifth of an inch in thickness.

It seemed a matter of some interest to examine this crust in order to see how the mineral in question changes chemically when disintegrating by partial exposure to atmospheric influence in contact with decomposing felspathic rock. The crust where thickest was found to be composed of two layers, an outer one nearly white, and an inner one of brick-red colour: both were earthy and pulverulent in texture. The following were the results of the analysis of these layers, the third column giving the composition of the unaltered allanite as determined formerly by Mr. Cabell:—

	Crust.		Original Mineral.
	Outer Layer.	Inner Layer.	
Silica	21·37	8·05	31·23
Alumina	20·66	16·83	16·45
Ferric oxide	12·24	37·14	3·49
Ferrous oxide	—	—	13·67
Cerous oxide	21·90‖	7·13‖	11·24
Lanthanum oxide	—	—	9·90
Didymium oxide	—	—	
Yttria	—	—	1·65
Glucina	1·95	0·94	0·24
Lime	—	—	8·69
Magnesia	—	—	0·22
Water	21·37	29·55	2·28
	99·49	99·64	99·06

Hence it appears that calcium, magnesium, yttrium, and didymium have been entirely removed, the last named so completely that no absorption-bands could be seen with the spectroscope in a strong solution contained in a cell 6 inches through; lanthanum has almost disappeared; the quantity of cerium has been somewhat reduced, and then relatively much increased by removal of other substances; iron has been first peroxidised, and its relative amount largely increased by removal of other constituents, and has subsequently been itself in great part removed; alumina and glucina have resisted removal, and have therefore relatively accumulated; much silica has been withdrawn, but the more rapid removal of iron in the outer layer has led to an apparent increase again; and water has largely increased by formation of ferric hydrate, diminishing again as this latter has been removed in the outer layer.

(To be continued.)

* See similar results obtained by Wright and Luff for carbon prepared from sugar and from carbon monoxide.—*Chem. Soc. Journ.*, Jan. 1878, pp. 18 to 20.

* Including the C and H of 0·024 solid hydrocarbon.

† These gases were doubtless partly formed from solid carbon and occluded oxygen by the heat applied in vacuo.

‡ See analysis (by Mr. J. A. Cabell) in this laboratory and description.—CHEM. NEWS, vol. xxx. p. 141.

‖ Including a trace only of lanthanum oxide, obtainable by treatment with yellow mercuric oxide and potassium permanganate.

ON THE PHTHALEINS OF PYROGALLIC ACID.

By M. DURAND.

Gallein and cerulein, new tinctorial derivatives from pyrogallic acid, were discovered by the chemist Baeyer, who published a description of their reactions in 1871. Since that epoch no important publication on the subject has taken place; indeed, M. Baeyer pointed out the preparations and properties of these compounds so fully that their study seemed at once completed.

Three years subsequently the firm of L. Durand and Huguenin, of Bâle, undertook the manufacture of these products, and placed their first results in the hands of M. Horace Kœchlin in June, 1874. The result of the researches of this chemist was that chromic oxide is the best mordant for gallein and cerulein, and that the latter, both for printing and dyeing, should be mixed with sodium bisulphite.

Gallein is obtained by the reaction of phthalic acid upon double its weight of pyrogallic acid. The mixture is kept at 190° to 200° C. till the mass hardens. The crude product of this reaction is treated with boiling water in order to extract such portions of the materials as have escaped transformation. The result is dissolved in an alkaline carbonate and precipitated with an acid, which throws it into the state of "carmination" necessary for its use as an application colour.

Gallein is slightly soluble in boiling water, to which, nevertheless, it imparts a vinous-red colour; it is substantially insoluble in cold water, but very soluble in hot alcohol, the solution having a fine mahogany colour. In caustic alkalies it dissolves with a blue-violet colouration. These solutions if concentrated are rapidly transformed if exposed to the air, losing their blue shade and producing brown substances.

Gallein is variously acted upon by metallic oxides, the chromic used as indicated by M. Horace Kœchlin giving the finest shades:—

40 litres gallein in paste.
20 litres gum water.
4 litres acetate of chrome at 18° B.

Care must be taken to print both gallein and cerulein upon cloth prepared with the sulpholeate of ammonia.

Gallein dyes both cotton and wool if previously impregnated with chromic oxide, which may be easily effected by mordanting the goods, either in solutions of chrome alum or by alternate passages through chromate of potash and sulphate of soda, or, in place of the latter, by exposure to free sulphurous acid.

Cotton mordanted with oxide of lead is dyed a very beautiful violet-grey shade. The dyeing, after mordanting, is begun as in the case of madder, adding to the bath the proportion of colour necessary for the shade intended, and raising the temperature gradually to a boil. After dyeing the colour may be developed by a hot soaping. These shades have a fastness rivalled only by madder and indigo.

Upon wool gallein gives in printing the tones of orchil extract, though somewhat less blue; exactly similar shades may be obtained by the addition of methyl-violet, or of alum. For the present the price of gallein is too high as compared with that of orchil extract; this substitution therefore presents no practical interest.

Cerulein.—This green colouring matter is a derivative of gallein; in its use and in its properties it presents the same features, requires the same mordants and the same precautions, both in dyeing and printing.

Its insolubility in water is still greater than that of gallein, and it becomes necessary to render it more soluble by a slight reduction, which M. Horace Kœchlin obtains by additions of bisulphite of soda, either in the dye-bath or in the printing colour. For the latter purpose he proposed the following formula:—

For wool—

10 litres cerulein.
30 litres gum water.
1½ litres glycerin.
1½ litres bisulphite of soda (added at the moment of use).

For cotton—

20 litres gum water.
8 litres cerulein.
1 litre bisulphite of soda (added at the moment of use).
2 litres acetate of soda at 18° B.

With additions of alizarin and of Persian berries, or of any other yellow, or of catechu, these receipts may be converted into bronzes, olives, and mosses, which, as compared with the combinations of aniline green, logwood, &c., afford an advantage in point of solidity which the manufacturers of furniture-prints well know how to appreciate. These new colours are easily applicable to resist styles.

M. Horace Kœchlin recommends also for printing, as a mordant, yellow prussiate, employed in a maximum of ¼ kilo. per litre of cerulein. This proportion gives shades somewhat too blue, due to the simultaneous production of Prussian blue, which disappears on soaping, yielding a greyer tone but of an intensity proportionally greater than that of the shades fixed with chromic oxide.

For dyeing wool and cotton it is necessary to proceed exactly as above directed for gallein; only it is recommended, in order to obtain good results, to stir up 1 kilo. of cerulein with 2 kilos. bisulphite of soda at 40° B. This mixture may even be left for some hours before adding it to the dye-bath.

Cerulein can be reduced like indigo and re-oxidised on exposure to the air, upon tissues steeped in the reduction product, resuming its original colour. This method may be employed both in dyeing and printing. The most suitable reducing agent is zinc powder along with a little ammonia.

The shades dyed and printed with cerulein resist air and soap as well as do alizarin colours.

Cerulein is obtained by the action of concentrated sulphuric acid upon gallein, one part of which, previously dried, is heated to 200° with 20 parts of the acid. The product of the reaction is poured into water and washed till perfectly neutral.

Cerulein is neither affected by the caustic alkalies nor by acids. It may be regarded as the type of a fast colour, and it is the only green colouring matter, natural or artificial, which presents this precious quality.—*Bull. de la Soc. Indust. de Mulhouse.*

ON THE ORIGIN OF ELEMENTARY SUBSTANCES, AND ON SOME NEW RELATIONS OF THE ATOMIC WEIGHTS.*

(Continued from p. 69).

By HENRY WILDE.

Just as silver and copper are analogues of each other, and are frequently associated in nature, and, just as their homologues, cadmium and zinc, are analogues and are also found together, so is yttrium the analogue of $x=69$, and will be found associated with it in nature. Now, if $x=69$ be not the terbium of Mosander and Delafontaine, and the researches of Bahr and Bunsen render the existence of this element doubtful, it is probable that $x=69$ is cerium, as this element and yttrium are nearly always found associated in the mineral species cerite and

* A Paper read before the Manchester Literary and Philosophical Society, April 30, 1878.

yttrocerite. Moreover, it will be observed that $x=69$ is just 1·5, or 0·75 the atomic weight of cerium, according as it is regarded as 46 or 92. Mendeleeff and other chemists have already proposed 138 as the atomic weight of cerium,* which is double that of $x=69$. MM. Hildebrand and Norton have recently obtained cerium, lanthanum, and didymium in a massive state, and have thereby been able to investigate some of the physical properties of these rare metals.† According to these experimenters the specific gravities of Ce, La, Di range between 6 and 6·7. Bearing in mind that elements of approximately the same atomic weights and specific gravities generally belong to different series, and that the specific gravities of analogous members in each series increase in the order of their atomic weights, it would appear that cerium does not belong to the same series as lanthanum and didymium. Moreover, considering the important position which $x=69$ occupies in relation to its analogues Al, Y, and the position which these three elements occupy in relation to their homologues Mg, Zn, Cd, and Na, Cu, and Ag, it may be doubted if $x=69$ should, up to the present time, have remained undiscovered, especially as all its analogues of the series Th, E, Y, and Al are well known. If, therefore, $x=69$ be cerium, the only element missing in the series $H3n$ is $x=42$, the analogue of Ga, In, and Tl. As these elements have been discovered by spectrum analysis, it is probable that $x=42$ will also be found by the same means. It may, however, be observed, that the characteristic lines of the alkaline metals in the series Hn, and of their homologues $H3n$, advance in the blue or violet end of the spectrum towards the more refrangible parts in the inverse order of their atomic weights. The spectral lines of $x=42$ must therefore be sought for in the violet or ultra violet part of the spectrum. The high refrangibility of the lines which the missing element will have may be the reason why it has hitherto escaped detection, as from the wide distribution in nature of its homologues of position Ca and K, in relation to their respective analogues Sr and Rb, $x=42$ ought to be more abundant in nature than gallium.

From the physical and chemical relations which subsist among the halogens Fl, Cl, Br, I, and the alkaline metals Li, Na, K, Rb, Cs, chemists have already justly considered these elements as positive and negative analogues of each other and of hydrogen. In accordance with this view, I have classified the halogens as negative forms of the series Hn. By assigning to these elements the positions shown in the table, it will be seen that besides the triad of atomic weights formed by Cl, Br, and I, there is a common difference of 4 between the atomic weights of the halogens and their positive homologues of position Na, K, Rb, and Cs. Now if the groups of oxygen elements O, S, Se, Te, be considered as negative forms of $H2n$, homologous in character and position with the negative forms of Hn, it will be seen that besides the triad of atomic weight formed by S, Se, and Te, there is a common difference of 8 between them and their positive homologues Mg, Ca, Sr, and Ba; or double the common difference between the positive and negative members of the series Hn. The oxygen elements are multiples of 2, 4, 8, and 16, and may accordingly be considered as products of the first, second, third, or fourth power of $H2n$. Whichever view be taken of the formation of the first negative member of the series $H2n$, it is probable that both fluorine and oxygen were not formed direct from Hn and $H2n$, but from members homologous in position with Li and Gl, but which have become extinct by absorption into F and O.

Another numerical relation subsisting among the halogens which it may be of interest to point out is, that the difference of a unit in their atomic weights will make them multiples of 3 and 9, and these numbers, commencing with Cl=36, are all respectively three times the atomic weights of the first three members of the series $H3n$. These relations would indicate that the halogens, usually regarded as monatomic, are also built up in multiple proportions, and may also throw some light on the variable quantivalence which Wanklyn and other chemists have shown the alkaline metals and halogens to possess.

The recent researches of chemists leave no doubt that all the elements which I have classified as forms of $H5n$, except boron, belong to the same group. Now, boron bears a greater resemblance to phosphorus in its combinations and occurrence in nature than it does to other elements, and whether the first three members of the series be considered as forms of $H5n$, or $H5n+1$, they form a triad as well defined as their homologues of position in $H3n$, $H2n$, and Hn. Triads are also formed by antimony, arsenic, and phosphorus:—bismuth, antimony, and phosphorus:—tantalum, niobium, and boron:—$x=140$, As=75, and B=10:—$x=140$, Nb=95, and V=50. The atomic weights of boron, phosphorus, and vanadium have been so carefully determined by chemists as to preclude any doubt of their being represented by $H5n+1$ rather than $H5n$; but the fact that arsenic, antimony, and bismuth are better represented by the formula $H5n$, and that Cu and Zn, in the series Hn and $H2n$, exhibit the same constant minus difference from the classical atomic numbers, as B, P, and V, are further indications of some unknown property of the elements which conceals their exact multiple relations from view. If the discovery of two new elements of this group by Hermann,* to which this chemist has given the names of neptunium, and ilmenium be confirmed, the former element will have an atomic weight of 140, and the latter element an atomic weight of 165, as shown in the table.

Although the numerical relations of the members of the series $H5n$ are very interesting, yet it will be seen that the ratios are not so simple as those of the series Hn, $H2n$, $H3n$, as multiples of the second member, minus the first, do not give the atomic weights of the other members of the series.

The series $H4n$, besides being incomplete by reason of the absence of several of its members, the atomicity of lanthanum and didymium is not yet agreed upon by chemists. There can, however, be no question as to the position of titanium as the third member of this series, as there is no other place vacant where an element with an atomic weight of 48 would fit, while the isomorphism of rutile with cassiterite and zirconia indicate the relation of tin and zirconium with the same series.

The classification of uranium presents some difficulty on account of the fewness of its analogies with other elements, but there can be little doubt that the atomic weight assigned to U=120 until recently is much too small; as there are no elements with atomic weights so low correlated with specific gravities so high as that of U=18·3. From a study of the chemical combinations of this element, Mendeleef has assigned to it the atomic weight of 240,† or double the number formerly received, and which number I have adopted. The admission of this high atomic weight, however, separates uranium from chromium, molybdenum, and tungsten, with which it has been classified, as there are no elements of approximately the same high specific gravities as tungsten=18·26, and uranium=18·3, correlated with so great a difference of atomic weights as U=240 and W=184. From the fact that the highest places in all the series, except that in $H4n$, are filled up with their highest members, and that uranium is generally found in combination with the mineral species *yttrotantalite*, *fergusonite*, *polykrase*, *pyrochlore*, *pyrrhite*, containing elements of the series $H3n$ on the one side, and in combination with minerals containing elements of the series $H5n$ on the other, I have classified uranium as the highest form of $H4n$. The two lower forms of $H4n$, as will be seen

* *Ann. Chem. Pharm.*, Suppl. viii., 185—190.
† *Chem. Soc. Journal*, 1876, vol. ii., 276.

* *Nature*, April 12th, 1877. *H. Kolbe's Journal für praktische chemie*. Feb. 1877, p. 105—150.
† *Ann. Chem. Pharm.*, Suppl., viii., 178—184.

from the table, are missing; but, assuming that titanium is the highest member in a triad with the missing elements, the atomic weights of the latter are 16 and 32, isomeric with oxygen and sulphur. It may, however, be surmised that no elements now exist to fill the gaps in the series, as they may have become extinct by absorption into titanium and its analogues, or by transformation into the negative forms of $H2n$.

The elements which I have classified as forms of $H6n$ are only three in number, and the atomic weight of chromium = 52·2 establishes its position as the third member of the series, and there is no other place for an element with the chemical and physical properties of chromium vacant in the table. For like reasons the positions in the series of molydenum and tungsten (the analogues of chromium) are also determined. By assigning to chromium the constitution $9H_6$, it forms a triad with the missing element $x = 36$, and $x = 18$, which are within a unit the atomic weights of fluorine and chlorine.

In the arrangement of the elements which I have classified as $H7n$ little assistance is derived from known analogies when nitrogen and silicium are admitted in the same series with the iron and platinum groups of metals; yet, it might be expected that elements so abundant and so widely diffused in nature as nitrogen, silicium, and iron, would occupy important positions in any rational classification of elementary species. We have seen that the first three places in the preceding series Hn, $H2n$, $H3n$, $H5n$ are all occupied by elements with atomic weights which exclude nitrogen, silicium, and iron, while the latter element is excluded from the series $H4n$ and $H6n$ by chromium and titanium. The atomic weight of N, Si, and Fe, besides being whole numbers, are exact multiples of 7. N and Si are, consequently, excluded from the vacant homologous positions in the series $H4n$, $H6n$.

Since the investigation of the properties of silicium by Berzelius, who regarded silicic acid as a trioxide, much discussion has arisen as to whether the atomic weight of silicium be 21 or 28; or the formula for its oxide SiO_3 or SiO_2. Chemists are now generally agreed upon the latter formula for silicic acid, and have accordingly classified silicium with titanium, as the oxide, SiO_2, agrees with titanic acid, TiO_2. Now, if silicium were the true analogue of titanium, the oxides of these elements should be isomorphous, whereas the crystalline form of quartz is hexagonal, while rutile, anastase, brookite, zirconia, and tinstone (similar oxides of members of the series $H4n$), are tetragonal: consequently, silicium does not belong to the series $H4n$.

By assigning to silicium the atomic weight 35, it forms with nitrogen and iron a triad similar to the first three members of Hn, $H2n$, $H3n$, $H5n$. The position of Si = 35 as the second member of the series $H7n$ not only throws new light on the disputed atomicity of this element, but also explains the anomalous atomic heat which has been assigned to it.

Through the classical researches of Regnault the specific heat of silicium was found to be 0·176.* The determination was made with specimens of the metal of considerable size, and in a state of compactness and purity, to receive a polish which formed a perfect mirror. The above number multiplied by 28, the highest atomic weight assigned to Si, gives the product 4·93, while the law of Dulong and Petit requires the value 6·25.

In discussing the cause of the anomalous atomic heat of silicium, Regnault pointed out that in order that it might enter into the law of the specific heat of other elements, it would be necessary to write the formula of silicic acid Si_2O_5; it would then resemble that of nitric, phosphoric, and arsenic acids. The atomic weight of silicium would then be 35, and the product of this number and the specific heat would be nearly 6·25, which agrees with the analogous products which other simple bodies give. By assigning to silicium a higher atomic weight and a polybasic character like that of phosphorus or nitrogen, Regnault remarked that it is easy to explain the existence of the great number of silicates which nature presents in well defined and beautiful crystals, and to understand the existence of the natural hydro-silicates.

Whichever view chemists may ultimately adopt in regard to the constitution of silicic acid, or whether its atomic weight be fixed at $3H_7$, $4H_7$, or $5H_7$, silicium will still retain its positions as the second member of the series H_7n. The chief properties which distinguish the elements of the series H_7n are their high fusing point; their occlusive affinity for hydrogen; and their passivity in the presence of ordinary reagents, to which iron, under peculiar conditions, forms no exception. In regard to their occlusive affinity for hydrogen; the relation of nitrogen to iron and palladium may explain the existence of the ammonium amalgam, in which nitrogen and hydrogen are held together in the nascent state by means of mercury. The formation of silicium hydride by electrolysis, in a manner analogous to that of the ammonium amalgam, would also indicate for silicium a similar occlusive affinity for hydrogen to that possessed by nitrogen.

Although gold in some recent classifications of elements has been separated from the platinum metals, yet, in its primary qualities, it exhibits closer analogies with them than with the members of any other series, and there is no other place vacant in the groups which an element with the atomic weight and physical properties of gold would fit. The constant association in nature of quartz, hematite, and specular iron ores with gold and platinum is a fact fully recognised by chemical geologists,* and confirms the positions assigned for Si, Fe, and Au in the table as forms of $H7n$.

The remarkable resemblance which the members of the iron group have to one another, while their atomic weights are nearly if not exactly the same, has long been a subject of much interest to philosophical chemists, and if the views which I have enounced respecting the formation of elementary species by condensation be correct, the cause of these resemblances admit of a possible explanation. From the great abundance and wide distribution of iron in nature, it is probable that the vapour of this element would form a zone of considerable depth; the upper and lower regions of which, by differences of pressure and temperature might produce allotropic varieties before a definite change to the next higher members in the series occurred. When once varieties of an element were formed, these varieties would be propagated through successive condensations into the next higher members of the series, just as they are found in the palladium and platinum groups of metals. Chemists have already observed that each of the metals of the palladium group appears to be more especially correlated with some particular member of the platinum group, and all are found associated together naturally in the metallic state. If the four members of the platinum group be considered the analogues of the corresponding members of the iron and palladium groups, it will be seen that one of the members of the latter group is missing. M. Sergius Kern, a Russian chemist, has recently discovered a new metal which he classifies with the platinum group, and has given to it the name of davyum.† The specific gravity of the new metal was found to be 9·39, and preliminary experiments on its equivalent show that it is greater than 100 and supposed to be 150—154. Now the specific gravity and atomic weight of the new metal exclude it from the platinum group, and also from the iron group of metals; davyum is therefore the missing element in the palladium group, and will have a specific gravity of about 11, and an atomic weight of 105; or the same density and equivalent as the other members of the group. The state of aggregation of the small quantity of the new metal obtained by M. Kern may have prevented the same

* *Annales de Chimie et de Physique*, tome lxiiii, 24-32, 1861.

* Bischoff's Chemical and Physical Geology, vol. iii., 534. Cavendish Soc. Works. "Murchison's Siluria," chap. xvii., 433-439.

† CHEM. NEWS, vol. xxxiv., pp. 4, 114, 155.

specific gravity being found for it as for the other members.

Although I have designated the highest members of the series H_{7n} as the platinum group, yet if the slight differences in their atomic weights and physical properties admit of explanation by the assumption of their being allotropic varieties of each other, then gold, palladium, and iron may stand at the head of their respective groups, and determine the species to which the varieties belong. It is no objection to the theory of the members of the respective groups being varieties of each other, that they cannot by any known power of analysis be resolved into their primaries, as the same objection would apply to the natural varieties of organic species determined by naturalists.

(To be continued).

CORRESPONDENCE.

WORKING UP NAPHTHALIN FOR USEFUL PRODUCTS.

To the Editor of the Chemical News.

SIR,—With regard to Mr. J. Marzell's letter in the CHEM. NEWS (vol. xxxviii., p. 58) I still adhere to the text of my former letter, because I cannot understand the value of descriptions of processes which are at variance with already ascertained fact and experience. Surely, too, in writing for non-chemists one cannot be too careful in this respect, and that they should be made aware of all that has been done practically. With respect to the latter part of Mr. Marzell's letter, I don't think it worth my while to reply to this gentleman's stigma on my results as "non-results," but leave these to the decision of the readers of my papers in the journals I quoted in my last, and also of such works as Schorlemmer's, Buchner's, Gorup-Besanez, and others on organic chemistry, where my results are accepted and recorded. Any sensible man reading my papers will see I lay no claim but to *the products of the action of heat on naphthalin* as the field of work which I discovered myself, after Berthelot had already worked at and given up the subject long before, stating his final results. Mr. Marzell says I wish to appropriate that "burning question," the "naphthalin theme," for my special leisure and use, and under cover of this accusation seeks to convince the readers of the CHEMICAL NEWS that as I claim unjustly so large a subject, so wide a field, he has as good a right to work in it as I. This were plausible if it were true. But the accusation is not true, and under its cover he would apparently strive to break in upon my *small corner of this field*, and by ignoring all I have previously done (see his paper, CHEM. NEWS, vol. xxxvii., page 258), would seem desirous of wresting it from me even, or appropriating it. I think "It may well be asked," then, how Mr. J. Marzell can conscientiously ignore the investigations of another man, and actually propose for himself the very problem solved by these investigations, endeavouring apparently to give his non-chemist readers the idea that no previous work worth naming had been done in this direction.—I am, &c.,

WATSON SMITH.

THE WORD "LABORATORY."

To the Editor of the Chemical News.

SIR,—Will any of your learned readers give me some clue to the proper pronunciation of the word "Laboratory"? Among my English, Scotch, and Irish acquaintance there are scarcely two who say it exactly alike; and I know one gentleman, an eminent chemist, who pronounces it in two distinct manners—*i.e.*, sometimes one way and sometimes another.

There are persons who say Läbŏrătŏry; others, Läbŏrătŏry; and others, again, Läbŏrătŏry.

The French place the accent on the second syllable—Laboratoire; but the Latins laid it on the fourth—Laboratorium: the Germans adopt the latter pronunciation, I believe.

I have consulted several Dictionaries, but they all shuffle out of the difficulty. Do, if possible, let us have the proper pronunciation determined once for all, and stick to it.—I am, &c.,

DIDYMIUM.

London, August 9, 1878.

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS.

To the Editor of the Chemical News.

SIR,—In the third report drawn up by Mr. Allen on behalf of the Committee appointed by the British Association to report on the estimation of potash and phosphoric acid in commercial products there occur some statements on which I should like to offer a few remarks. The report distinctly declares that the work of the Committee has been solely to collect such evidence as has been placed at its disposal, and not to make any definite series of experiments; but are the Committee quite sure that by this means they have been fully able to comprehend all the difficulties and sources of error to which the processes are liable? Each member (biassed probably in favour of the process which he himself could work best) would come with his opinion already formed, and would not very readily give credence to the statements of other chemists when they clashed with his preconceived ideas, and especially when he only had the warrant of their accuracy *on paper*. With the remarks on the molybdic acid method and the methods for the estimation of precipitated phosphates I entirely agree, but in the other processes it seems to me that they have entirely shirked the difficulty. In speaking of the oxalic acid method they say it is advisable to separate the iron and alumina before the precipitation of the phosphoric acid with magnesia mixture, and undoubtedly this would have the effect of making the estimation of the phosphoric acid remaining in the filtrate more accurate; but how about the phosphoric acid remaining with the iron and alumina? This precipitate is not a constant chemical compound, as we should be inclined to infer from the simple way in which the Committee appear to treat it. After the acetate of ammonium precipitate has been weighed it is necessary to analyse it if we want to get accurate results, and the very error which the Committee are desirous of guarding against is here introduced, unless the phosphoric acid be determined by Sonnenschein's method. It is not sufficient to only determine the iron and calculate the precipitate as consisting entirely of phosphates of iron and alumina, for even when precipitated in the cold it is sure to contain a greater or less amount of phosphate of lime. Further, all the iron and alumina does not appear to be in the state of phosphates, for on analysing the acetate of ammonium precipitate (as I have had frequent occasion to do) it will be found that the phosphoric acid very rarely exceeds one-third of the weight of the precipitate, whereas if it were all phosphate of iron it ought to be nearly one-half of the weight.

The only advantage of first separating the acetate of ammonium precipitate (at all events when the iron and alumina are not wanted) is that it gives the operator some idea of the quantity of citric acid required to keep the iron and alumina in solution, but for those who are constantly working with phosphatic materials and superphosphates this is superfluous, as by a mere glance at the sample it is not difficult to determine the amount of citric acid required; and, moreover, the previous separation necessitates two determinations of phosphoric acid instead of one. Of course, in the estimation of phosphoric acid

as ammonio-magnesic phosphate its solubility in strong ammonia water (1 in 4) must not be overlooked, although nothing is said on this head in the report.

The above remarks with regard to the acetate of ammonia precipitate apply with equal force to the uranium process as advised by the Committee.

Finally, when the amount of alumina is large, the oxalic acid and uranium processes are inapplicable, the only trustworthy method, so far as I know, being Sonnenschein's.—I am, &c.,

ALFRED SMETHAM.

1, Park Lane, Stoke Newington, N.,
August 19, 1878.

ROSS'S "PYROLOGY."

To the Editor of the Chemical News.

SIR,—In answer to the inquiry of Major Ross (CHEMICAL NEWS, vol. xxxviii., p. 45), I will state that I have very often heard of his work on "Pyrology," through his interesting contributions to the CHEMICAL NEWS, but never had any opportunity of seeing that work.

If Major Ross has a prior claim on the candle covered with tin-foil, I shall take great pleasure in communicating the fact to all those who have published my paper.—I am, &c.,

P. CASAMAJOR.

Brooklyn, August 8, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 4, July 22, 1878.

Theory of Fermentation.—M. Pasteur.—The author quotes from the papers of the late Claude Bernard the following passage condemnatory of his own theory of fermentation:—"Theory of Alcoholic Fermentation.—The theory is destroyed. (1.) It is not life without air, for in the air, as well as in its absence, alcohol is formed without yeast. (2.) The ferment is not derived from external germs, for in aplasmic or unfruitful juices (verjuice, &c.) the ferment is not evolved, though they are sweetened. If a ferment is added then they pass into fermentation. (3.) Alcohol is formed by a soluble ferment exterior to life in ripening or putrefying fruits; there is then a decomposition of the fruit and not a biosic synthesis of yeast or of vegetation. Air is absolutely necessary for this alcoholic decomposition. (4.) The soluble ferment is found in the juice extracted from the fruit; the alcohol continues to be formed in it and to increase. With the infusion of old yeast its demonstration becomes still easier. (5.) In fermentation there are two conditions to be studied:—*a*. Decomposition. *b*. Morphologic synthesis." He then seems to censure M. Berthelot for the publication of these notes. He declares "The existence of these notes and the enormous disproportion between the conclusions and the facts which support them seem to have an explanation very different from that which M. Berthelot has suggested to the readers of the *Revue Scientifique*, inviting them to believe, upon the faith of *on dits*, that the declarations of Claude Bernard, a few days before his death, were entirely conformable to the general affirmations of the Notes of Saint Julien" (*i.e.*, M. Bernard's country seat, where these notes were drawn up).

Observations with Reference to the Researches of M. Rosenstiehl on the "Absolute" or "Ideal Black."—M. Chevreul.—The author quotes a passage written in 1835:—"If the light falling upon a body is completely absorbed by such body, so as to disappear from view, as if falling into a hole perfectly dark, then the body appears to us black, and only becomes visible because it is contiguous to surfaces which reflect or transmit light. Among black bodies we know none which is perfectly so, and this is because they reflect a little white light by which they affect our sight. What proves this reflection of white light is that the blackest surfaces if polished reflect the images of illuminated objects placed before them."

Electro-chemical Deposition of Cobalt and Nickel.—E. Becquerel.—With reference to the recent paper on this subject by M. Gaiffe (*Comptes Rendus*, p. 100) the author states that the same methods had been pointed out in 1862 by his late father and himself.

Variation of the Intensity of Currents Transmitted through Imperfect Contacts According to the Pressure Exerted upon them.—Th. du Moncel.—With reference to the wonderful results obtained by Edison and Hughes by the use of currents of an intensity varying with the pressure exercised upon the contact-pieces of a circuit-joiner, the author calls the attention of the Academy to the researches which he has undertaken at different epochs on this kind of effects. Thus, in 1872, when commencing his great investigations on the conductive power of imperfect conductors he was led to measure the resistance of charcoal dust and of metal filings, which he found to vary according to the more or less brilliant state of their surfaces and the manner in which they are aggregated around the electrodes.

New Earth of the Cerium Group with Remarks on a Method for the Analysis of the Natural Columbates.—L. Smith.—The author has already communicated to the Academy (*Comptes Rendus*, lxxxiv., p. 1036) the discovery of two new columbates, and has published (*Annales de Chimie et Physique*, series 5, vol. xii., p. 253) a description of all the columbates hitherto found in the United States. In a future communication he will make known the analytical methods employed, and the true nature of the earths which enter into the composition of several of these minerals. The object of the present note is to call attention to the use made for their solution of concentrated hydrofluoric acid, whose action, especially upon the samarskite and euxenite of North Carolina, is as rapid and energetic as that of hydrochloric acid upon calcareous spar. If finely-powdered samarskite is taken, moistened with its own weight of water, and treated with twice its weight of fuming commercial hydrofluoric acid, the attack takes place in the cold in a few seconds, the mass heats with a slight effervescence, and the decomposition is effected in from five to ten minutes. If needful the action may be assisted by exposure to the heat of the water-bath for a few moments. The capsule is then kept at the temperature of boiling water long enough to expel the excess of acid. The contents of the capsule are then treated with 30 to 40 grms. of water (to 5 grms. of mineral), thrown upon a filter, and carefully washed, adding, if needful, one or two drops of hydrofluoric acid. The mineral is thus separated into two portions: the filtrate, containing all the metallic acids and the oxides of iron and of manganese; and the insoluble precipitate, containing all the earths and uranic oxide. In a following memoir complete details on the separation of these two portions will be given. The difficulty of the attack increases with the proportion of tantalic acid in the minerals. The most interesting constituents of samarskite are the earths. In the description already published of the North Carolina variety the author merely arranged the earths in two classes: the yttria group and the cerium group, remarking that the latter probably did not contain oxide of cerium, and that the thorina detected in the variety from the Urals was present in too small quantity to be

recognised in a satisfactory manner. He has since found that the earths of the yttria group consist of about two-thirds yttria and one-third erbia. That there is no cerium in the group to which it belongs, but that these groups comprise about 10 per cent of thorina—or rather less than 1 per cent of the entire mineral—a very small quantity of didymic oxide, and an earth (to the extent of 3 per cent) which he regarded as new, if it is not the hypothetical erbia of MM. Delafontaine and Marignac, admit the existence of terbia. At present the author inclines to the belief that the earth in question is new, and that if terbia exists in the samarskite of North Carolina it must be found among the yttria group. On comparing the atomic weight of the new earth, carefully separated from thorina and didymic oxide, with those of the oxides of cerium, lanthanum, and didymium, as determined by M. Marignac, we find (O=16):—

New earth	109 (Smith)
Oxide of cerium	110 (Marignac)
„ „ lanthanum	110 „
„ „ didymium	112 „

The new earth differs from those of the yttria group by its behaviour with the sulphate of potassa; from ceric oxide by its solubility in very dilute nitric acid and in an alkaline solution traversed by a current of chlorine; from didymic oxide by its colour and other peculiarities, especially the absence of absorption-rays as spectroscopically determined in its solutions; from lanthanum oxide by its colour, the readier decomposition of its salts by heat, their crystalline forms, and other characters. The author has discovered an exact method for separating thorina from the other earths. It consists, like the method employed for separating cerium from didymium and lanthanum, in placing the oxides recently precipitated in water containing four to five times their weight of caustic potassa or soda and in passing a current of chlorine into the liquid. All the oxides are dissolved save those of cerium and thorium, and as the former is not present in the samarskite of North Carolina, the residue is a white precipitate, gelatinous like alumina. He has also discovered a simple process for separating the greater part of the thorina in operations on a large scale, but not sufficiently exact for analytical purposes. He gives no name to the metal of the supposed new earth, being engaged with the examination of a group of oxides and acids—eleven according to some chemists—interposed between columbium and the new earth.

Mosandrum; a New Element.—J. L. Smith.—Having read the interesting communication of J. L. Soret to the Academy of Sciences as concerns the absorption spectra of the earths of gadolinite in the ultra-violet rays, the author communicates to the Academy that the earth designated X was discovered by him more than a year ago; the discovery was publicly announced in the *Transactions* of the Academy of Natural Sciences of Philadelphia, in May, 1877. The author then gives a detailed history of the discovery.

Vapour Tension and the Congelation Point of Saline Solutions.—F. M. Raoult.—The difference of vapour-tension as well as the lowering of the freezing-point varies considerably with the nature of the dissolved salt. As regards the power of diminishing vapour-tension or of reducing the congelation point, the different anhydrous salts may be approximately ranked in the same order. The power of the anhydrous salts in producing the one or the other effect is generally so much the greater as the atomic weight is lower.

Presence of Lead in the Subnitrate of Bismuth.—MM. Chapuis and Linossier.—The authors propose a method for the detection of lead, and remark that out of twelve samples examined three only contained lead in appreciable quantity.

A New Non-saturated Hydrocarbide, Diallylen.—L. Henry.—Diallylen, C_6H_8, is a colourless limpid liquid, very mobile, of a strong and peculiar odour, and may be preserved indefinitely. It is insoluble in water, upon which it floats; soluble in alcohol, ether, sulphide of carbon, and petroleine. Its sp. gr. at 18·2°=0·8579. Under ordinary pressures it boils at 70°, a temperature intermediate between the boiling-points of diallyl and dipropargyl. Its vapour-density is 2·79.

Researches on the Presence of Lithium in the Soils and in the Thermal Waters of the Solfatara of "Pouzzoles" (Puzzoli?).—S. de Luca.—In the trachytic earths and thermo-mineral waters of the Solfatara of Puzzoli a small quantity of lithium is found in the state of sulphate.

Reimann's Färber Zeitung, No. 29, 1878.

This issue contains nothing of general interest.

No. 30, 1878.

Process for the Preparation of a Mordant for Turkey-reds as a Substitute for the So-called White Baths.—Dr. A. Muller-Jacobs.—The invention relates to the preparation of a peculiar oil, named Turkey-red mordant, for the production of Turkey-red in dyeing, and printing upon yarns and tissues of all kinds, with madder, and all preparations of madder, including artificial alizarin, purpurin, and all analogous colouring-matters. A single passage through this oil along with a proper addition to the colour-baths supersedes in printing and dyeing the usual and oft-repeated white-baths, and yields a colour not inferior to ordinary Turkey-red in beauty and fixity, and if applied to common madder colours imparts to them a peculiar lustre. The Turkey-red oil is a mixture of the sulpho-ricinoleate of soda, and the sulpho-pyroterebate of soda. The preparation is conducted as follows:—1. Sulpho-ricinoleate of soda. Castor oil, ordinary or purified, is mixed with 20 per cent of its weight of sulphuric acid, at 66° B., the acid being caused to flow into the oil in a thin stream. This operation is best conducted in iron vessels, lined with lead, on the bottom of which lie leaden tubes, in which ice-cold water is allowed to circulate, in order to prevent a rise of temperature in the syrupy mixture. After standing for two or three hours the mass is diluted with water at pleasure, and neutralised with a luke-warm solution of soda—2·8 kilos. soda crystals to every kilo. of acid employed. The alkaline liquid is added slowly and with constant stirring. The mixture is then allowed to stand over night. The next morning the sulpho-ricinoleate of soda is found separated, and after the removal of the water is ready for future use. If pure oil is employed the quantity of sulphuric acid may be reduced to 15 per cent. If impure castor oil is taken, 20 per cent will be needed, and in some cases even more. By sulpho-ricinoleic acid the inventor understands an acid of the formula—

$$C_{36}H_{32}O_4HO.SO_3+HO.SO_3.$$

i.e., ricinoleic acid, conjugated with sulphuric acid, resembling sulpho-glyceric acid, or Fremy's sulpholeic acid, which latter is formed on treating olive oil with concentrated sulphuric acid in the cold. The acid itself, and its alkaline and ammoniacal salts are readily soluble in water, but on prolonged standing or on boiling are decomposed, taking up water, and forming a fatty acid, closely connected with oleic acid (metaoleic or hydroleic acid), and sulphuric acid or sulphates. The inventor has examined the mixture of castor oil and sulphuric acid. The analytic results show that a compound is formed resembling sulpholeic acid. The aqueous solutions are precipitated by metallic salts, and on the decomposition of the latter by heat, *e.g.*, the lead precipitate, there remains a quantity of lead sulphate tolerably in harmony with theory. The glycerin simultaneously liberated by the treatment of the oil forms sulpho-glyceric acid, and forms an aqueous solution with

excess of sulphuric acid, from which the sulpho-ricinoleic acid and its salts are readily separated, being insoluble therein. The compound obtained is naturally not of absolute purity. Whilst castor-oil soaps have absolutely no power as mordants, the action of this substance as a mordant is readily intelligible. On mere exposure to the air there are formed in textile fibres steeped in this mordant salts of sulphuric acid, along with those of ricinoleic acids, analogous to metaoleic and hydroleic acids—which are also mordants—insoluble in alcohol, and soluble only in ether. They are scarcely attacked by strong alkalies. The same compound can be formed from olive oil by slow oxidation. No acid is necessary, in order to separate the alkali from a sulpho-ricinoleate. The substance is decomposed spontaneously, and the sulphate of soda is washed out. 2. Pyroterebate of soda is prepared by boiling, in enamelled iron vessels, 250 parts of rosin, which is powdered and added in small portions. After the lapse of 1½ hours the liquid is gradually concentrated, and the residue is heated for half an hour to 200° – 250° in closed iron vessels. When cold the semi-fluid mass is treated with 20 to 30 per cent of sulphuric acid at 656° B., and after two or three hours it is neutralised with soda, and the sulpho-pyroterebate of soda, which separates out of the solution of sulphate of soda, is reserved for use. To make up the mordant, equal volumes of the solutions of the sulpho-ricinoleate and of the sulpho-pyroterebate of soda are mixed, and used at once in the preparation of Turkey-red. Experiments with chemically pure products show that the best proportions are 6 to 7 parts of the sulpho-ricinoleate and 3 to 4 of the sulpho-pyroterebate. Instead of soda may be used potash, caustic alkalies, ammonia, alkaline earths, or their carbonates. Instead of the above-specified mixture, the inventor claims the use of a mixture of the sulpho-ricinoleate of soda or ammonia, with the mixture of sulpholeate and sulpho-margarate of soda or ammonia, formed by treating olive oil with sulphuric acid, and neutralising with ammonia.

Les Mondes, Revue Hebdomadaire des Sciences, No. 15, August 7. 1878.

According to the *Journal de Medecine et de Chirurgie Pratique* ergot of rye is of great service in typhoid fever.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following are the names of the Officers and Committee of Section B. (Chemical Science Section) of the Dublin Meeting of the British Association:—

President—Prof. Maxwell Simpson, M.D., F.R.S., F.C.S.

Vice-Presidents—Prof. Apjohn, F.R.S., F.C.S.; Wm. Crookes, F.R.S; Prof. Dewar, F.R.S.; Dr. J. H. Gladstone, F.R.S.; Sir R. Kane, F.R.S.; Dr. Longstaff; Prof. J. Emerson Reynolds, M.D., Ph.D., F.C.S., M.R.I.A.; Prof. Roscoe, F.R.S.; Prof. Rowney; Prof. A. W. Williamson, F.R.S.

Secretaries—W. Chandler Roberts, F.R.S.; C. R. Tichborne, M.D.; J. M. Thomson, F.C.S.; T. Wills, F.C.S.

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The papers brought before the Section were as follows:—

Dr. C. R. Alder Wright.—Report of Committee on the Chemistry of some of the lesser known Alkaloids.

Dr. Wallace.—Report on the best means of Developing the Light from Coal-gas. Part I.

A. S. Wilson.—On the Amounts of Sugar contained in the Nectar of various Flowers.

Dr. E. M. Davy.—Action of Chlorine on the Nitroprussides.

E. H. Cook, B.Sc.—The Adulteration Act, in so far as it relates to the prosecution of Milk-sellers.

Professor Roscoe, F.R.S.—On some Fluor Compounds of Vanadium.

Dr. J. H. Gladstone, F.R.S., and Mr. Tribe.—Notes on Aluminium Alcohols.

William Thomson, F.R.S.E.—On the Estimation of Mineral Oil or Wax in the Mixture of either of these Substances with other Oils or Fats.

C. A. Cameron, M.D., and E. W. Davy, M.D.—On the Action of Heat on Ammonium Selenate.

Louis Siebold.—Application of Silver Nitrate and Hydrocyanic Acid in Alkalimetry.

W. Lant Carpenter. B.Sc.—Notes on Water from the Severn Tunnel Springs.

Dr. E. A. Letts.—On the Thetines.

Dr. Johnstone Stoney and Prof. E. Reynolds, M.D.—On the Spectrum of Chlorochromic Acid.

Dr. W. Ramsay.—Summary of Investigations on the Pyridine Series.

Dr. W. Ramsay.—On some Derivatives of Furfurol.

B. C. Molloy.—Re-oxidation of the Peroxide and the Lower Oxides of Nitrogen, and their Conversion into Nitric Acid.

Dr. Phipson.—On some Substances obtained from the Root of the Strawberry.

Dr. Phipson.—On a New Mineral White Pigment.

Oliver J. Lodge, D.Sc.—On a Simplification of Graphic Formulæ.

W. Chandler Roberts, F.R.S.—On the Detection by means of the Microphone of Sounds which accompany the Diffusion of Gases through a thin Septum.

Professor Emerson Reynolds, M.D.—A Short Account of Baeyer's Synthesis of Indigo.

Dr. Ramsay.—To show Victor Meyer's Apparatus for taking Vapour Densities of Substances with High Boiling Points.

Professor J. Dewar, F.R.S.—On the Condensation of the Gases hitherto called Permanent.

Professor Wanklyn and W. J. Cooper.—On a Method of Elementary Organic Analysis by a Moist Process.

Dr. C. R. C. Tichborne.—On some Peculiarities of the Vartry Water, and on the Action of that Water upon Boiler Plates.

W. Willis, jun.—A New Proces of Photo-Chemical Printing in Metallic Platinum.

The meeting of the British Association for 1879 will be held at Sheffield, and will commence on August 6. Dr. J. Allman, F.R.S., has been nominated President-Elect, and the Vice-Presidents chosen are the Duke of Devonshire, the Earl of Rosse, the Earl of Wharncliffe, Prof. Huxley, and Prof. Odling. The meeting for 1880 will be held at Swansea.

Research Fund of the Chemical Society.—The following grants have lately been made from the Research Fund of the Chemical Society:—

£50 to Dr. Tilden, for an investigation into the chemical nature of the terpenes.

£50 to W. N. Hartley, Esq., of King's College, for apparatus and materials required in carrying on a research on the action of organic substances on the ultra-violet rays.

£30 to Dr. W. Ramsay, for determining the electric conductivity and resistance of solutions of salts at different temperatures.

£20 to W. Jago, Esq., for the purchase of apparatus required for carrying on a research on the organic matter in sea water.

£10 to W. A. Shenstone, Esq., for the examination of certain reactions of brucine and strychnine.

University of London.—The following is a list of the candidates who have passed the recent Examinations for Honours, First B.Sc., and Preliminary Scientific (M.B.) Examinations :—

(First B.A. and First B.Sc. conjointly.)

Mathematics—First Class; R. S. Heath, First B.Sc. (Exhibition), Trinity College, Cambridge; *R. A. Herman, First B.A., King Edward's School, Bath. Second Class: T. Beck, First B.Sc., University College. Third Class: M. W. Richmond, First B.Sc., University College; J. C. Tregarthen, First B.A., private study.

(First B.Sc. and Preliminary M.B. conjointly.)

Chemistry—Second Class: F. L. Teed, First B.Sc., University College and private study; T. W. Williams, First B.Sc., University College and Royal College of Chemistry. Third Class: E. J. Onions, Prel. Sci., private study; G. B. Hoffmeister, Prel. Sci., Caius College and St. Bartholomew's Hospital; E. H. Rennie, First B.Sc., University College and Royal School of Mines; S. L. Hart, First B.Sc., St. John's College, Cambridge.

Experimental Physics—First Class: J. W. W. Waghorn, First B.Sc. (disqualified by age for Arnott Exhibition and Medal), private study; S. L. Hart, First B.Sc. (Arnott Medal), St. John's College, Cambridge. Second Class: G. J. Burns, First B.Sc., Birkbeck Institute and private study; S. C. Hill, B.A., First B.Sc., University College; D. W. Samways, Prel. Sci., St. Bartholomew's Hospital; S. G. H. Barfield, First B.Sc., private study; A. E. Laloë, B.A., First B.Sc., private study; J. H. Hichens, Prel. Sci., Epsom College; E. J. Onions, Prel. Sci., private study. Third Class: B. Hall, Prel. Sci., St. Bartholomew's Hospital.

Botany—First Class: A. King, Prel. Sci. (Exhibition), University of Edinburgh. Second Class: C. E. Stuart, First B.Sc., University College and private study. Third Class: W. D. Halliburton, Prel. Sci., University College; J. H. Champ, Prel. Sci., Guy's Hospital.

Zoology—First Class: W. Overend, Prel. Sci. (Exhibition), Royal School of Mines and St Bartholomew's Hospital; *P. F. Frankland, Prel. Sci., Royal School of Mines and University College; A. G. Bourne, Prel. Sci., University College; J. J. Fletcher, Prel. Sci., University College and Royal School of Mines; J. R. Forrest, Prel. Sci., University College; W. D. Halliburton, Prel. Sci., University College; E. W. von Tunzelman, Prel. Sci., University College. Second Class: M. Parry-Jones, Prel. Sci., University College; E. Radford, First B.Sc., University College; J. H. Steel, First B.Sc., private study; W. F. R. Weldon, Prel. Sci., St. John's College, Cambridge. Third Class: J. Berry, Prel. Sci., St. Bartholomew's Hospital; E. Roberts, Prel. Sci., Guy's Hospital and Epsom College.

* Obtained the number of marks qualifying for the Exhibition or for the Prize.

TO CORRESPONDENTS.

J. Newlands.—Your paper on "The Periodic Law" is crowded out this week. It shall appear in our next number.

H. C.—Iodide of zinc and zinc-ethyl will be formed.

NOTICE.

The STUDENTS' NUMBER of the Chemical News will be published on Friday September 7th. Gentlemen holding official positions in the Universities, Colleges, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the education, who have not yet forwarded the necessary information to our Office for publication in that Number, will confer a favour by sending it with the least possible delay.

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The NEXT SESSION will COMMENCE :—In the Arts, &c., and Medical Departments, on the 1st October; and in the Evening Classes on the 14th October.—Candidates for admission must not be under fourteen years of age, and in the Arts and Science Department those under sixteen will be required to pass a preliminary examination in English, Arithmetic, and Elementary Latin.

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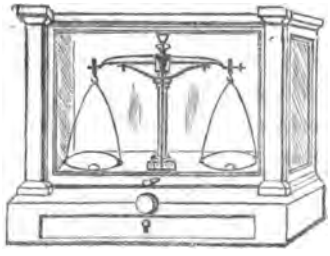

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 979.

ON THE

ACTION OF CHLORINE ON THE NITROPRUSSIDES UNDER DIFFERENT CIRCUMSTANCES.*

By EDMUND W. DAVY, A.M., M.D., M.R.I.A.,
Professor of Forensic Medicine, Royal College of Surgeons, Ireland.

The nitroprussides or nitroferricyanides, a class of salts obtained by the action of nitric acid on the soluble ferro- or ferricyanides, which were first studied by Dr. Lyon Playfair, have not received the attention that might have been expected from the interesting properties possessed by those combinations; and though it is now nearly thirty years since they were first investigated, still comparatively little has been added to the facts which were ascertained respecting them by their original investigator.

Having recently been engaged in studying the action of chlorine under different circumstances on those compounds, and the facts which I have noticed in connection with this enquiry being (as far as I can learn) hitherto unobserved, and as they tend to correct an erroneous statement which has been made respecting those salts, I thought it well to bring them under the notice of this Section of the British Association.

It is stated in the different standard works on chemistry, that chlorine exerts or has no action on the nitroprussides; but this I find is not the case, at least, as regards many of those salts which I have made the subject of experiment; for, although chlorine does not appear under ordinary circumstances to produce any immediate action (at least, on some of them), still when its operation is long continued, it effects a very slow decomposition of such compounds. If, however, its action is assisted by the agency of sun-light, it operates much more quickly, and soon produces the complete decomposition of those salts.

This combined action of chlorine and light on the nitroprussides being hitherto unnoticed, as far as I am aware, I have made it the subject of some research, and my experiments in this direction were chiefly made on the nitroprusside of sodium, it being the best known, and most easily procured of the nitroprussides.

When an aqueous solution of that salt was placed in a bottle of chlorine, and, after being well agitated with that gas, was exposed to the action of strong sun-light, it was observed soon to acquire a much deeper red colour, and that a small quantity of an oil-like matter floated on its surface, either in the form of a very thin film or in minute drops. By further exposure to such light the liquid gradually lost its red colour, and finally assumed a light yellow tint, whilst the oil-like matter increased in quantity, forming yellow globules, some of which sank to the bottom of the liquid.

The red colour of the solution having thus completely disappeared, it was examined, when it was found that after saturation with an alkaline carbonate, and separation of the oxide of iron formed, an alkaline sulphide no longer gave the slightest indication of the purple reaction characteristic of the soluble nitroprussides, showing that the sodium salt had been completely decomposed. On examining further the products of this complete decomposition of the nitroprusside of sodium, I was able to detect the presence of the following substances:—

The oil-like matter formed I found to possess all the properties belonging to the compound known under the name of chlorocyanic oil ($C_6N_4Cl_4$), a substance which is produced when chlorine in conjunction with sunlight acts on several compounds of cyanogen; ferric chloride, chloride of sodium, and hydrochloric acid; and I should add that the chlorocyanic oil formed, by the further exposure to light, was in part resolved into what appeared to be the trichloride of carbon, some crystals of which were observed to attach themselves to the upper portion of the bottle. As to the cause of the liquids acquiring a darker red colour in the early stages of its decomposition, my observations lead me to conclude that this is owing to the liberation of the nitroprussic acid, which, by the continued action of chlorine, is afterwards gradually decomposed, and when its decomposition is complete, the solution loses altogether its red appearance, retaining only the yellow tint of the ferric chloride.

The following nitroprussides, viz., those of potassium, barium, calcium, zinc, iron, manganese, and silver, were found to be decomposed similarly to that in the case of the sodium salt, when they were exposed to the combined action of chlorine and sunlight, the same ultimate products, together with chlorides of the metallic bases, being produced. And it is probable that many other nitroprussides will be similarly affected when placed under the same circumstances. The only one of those compounds which I have observed as yet that appears able to resist this combined action of light and chlorine is that of copper, which has remained apparently unaffected after some weeks exposure to their influence.

From an experiment I made by passing chlorine through a solution of the nitroprusside of sodium kept at a boiling temperature, it would appear that heat, like light, aids the decomposing action of chlorine on the nitroprussides. I may further add that according to my observations chlorine, even without the assistance of either light or heat, will decompose more or less completely some at least of the nitroprussides; for I found that when the nitroprusside of iron was introduced into a bottle of chlorine, it was almost instantly acted on, and after a few moments forms, even in the dark, a deep red solution. The manganese salt is likewise soon decomposed with the separation of the manganese as the peroxide. The nitroprusside of sodium, too, when left in contact with chlorine for a considerable time excluded from light, was found to be partially decomposed, as was shown by its giving a deep blue reaction with the ferrocyanide of potassium, indicating that the chlorine had withdrawn more or less of the iron from the compound radicle of the salt.

The foregoing observations are sufficient to show that the statements which have been made and are generally received as to chlorine having no action on the nitroprussides are quite incorrect, and are contrary to the facts which I have ascertained.

There are many obvious matters connected with this enquiry still remaining to be investigated, which a number of circumstances have hitherto prevented my prosecuting, but I hope ere long to be able to do so.

* A paper read before the Chemical Section of the British Association at Dublin, August 15, 1878.

ON A NEW MINERAL WHITE PIGMENT.*

By Dr. T. L. PHIPSON, F.C.S., &c.

For many years past attempts have been made by several chemists to discover some new mineral white of a less costly and less dangerous nature than white-lead, but very little success seems to have attended these researches until recently. Many years ago oxide of zinc, produced by the combustion of the metal in the air, was found to have certain properties which allowed it to be used as a substitute for carbonate of lead; but its production is very

* Read before the Chemical Section of the British Association Dublin, August, 1878.

costly, and its "body" is not comparable with that of the latter. More recently an ingenious white or stone-coloured paint was economically produced from oxide of antimony, by Dr. Stenhouse, which appeared to answer very well in certain circumstances. During the last few years I have also made a great number of experiments in the same direction, hoping to utilise some of the artificial silicates which are remarkable for their brilliant white colour. To this effect I have submitted the silicates of zinc, magnesia, and lime, more especially, to a great variety of treatments, but have been hitherto unsuccessful in imparting to them anything like the "body" or covering power of lead carbonate. They all become more or less translucid when mixed with oil, and resemble in this respect pure silicic acid, whatever mechanical treatment they may have previously undergone.

Whilst occupied with these experiments I learnt that Mr. T. Griffiths, of Liverpool, had obtained a new mineral white, the basis of which was sulphide of zinc; and on submitting this new product to a careful examination I found, with astonishment, that it not only surpassed the old zinc white (oxide of zinc), but that it was superior in every respect to carbonate of lead itself. It is obtained by precipitating either chloride or sulphate of zinc by means of a soluble sulphide,—sodium, barium, and calcium sulphides have all been used for this purpose,—and precautions are taken lest any iron, that may be contained in small quantities as an impurity in the zinc solution, should be precipitated with the sulphide of zinc.

The precipitate, being collected and dried, is transferred to a furnace, where it is calcined for some time at a cherry-red heat, and carefully stirred, so as to bring all parts of it successively in contact with the air; it is then raked out, whilst quite hot, into vats of cold water, when it is levigated, and afterwards collected and dried. The result is a white pigment of exquisite beauty; its covering power when mixed with oil is greater than that of any substance hitherto discovered, being about 25 per cent higher in this respect than that of the same weight of the pure carbonate of lead.

According to my analysis of this new product, it consists of an oxysulphide of zinc, the composition of which varies somewhat according to the duration of the calcination and the exact degree of heat attained. Hence it is not an easy matter to get it precisely of the same composition at each successive operation. Nevertheless this point is attained quite closely enough for all practical purposes. The best product appears to correspond very closely with the composition $5ZnS+ZnO$. But occasionally a somewhat larger quantity of oxide is produced.

Of course a white of this nature is not liable to darken in colour by sulphuretted hydrogen emanations, as occurs with white-lead; but it has also the advantage of not proving prejudicial to the health of the workmen who manufacture it or who use it. I have compared it carefully with the old zinc white and with white-lead, as regards covering power, tint, and durability, and am perfectly surprised at the results of these experiments, which would be too long to record here; but knowing as I do, from the results of my own endeavours, how difficult it has been to discover a new white of these qualities, I look upon this oxysulphide of zinc white as one of the most interesting products hitherto derived from mineral chemistry.

On Dehydro-mucic Acid. — R. Heinzelmann. — The composition of this new acid is $C_6H_4O_5$. It is distinguished from mucic acid merely by the absence of 3 molecules of water. It is sparingly soluble in cold, but readily in hot water, and crystallises from the hot aqueous solution in long colourless needles of a silky lustre. In alcohol it is less readily soluble than in water, and in ether almost insoluble. If cautiously heated it may be sublimed almost without decomposition, and does not fuse. If quickly heated to a high temperature it is decomposed.—*Liebig's Annalen.*

ON THE PERIODIC LAW.

By JOHN A. R. NEWLANDS, F.I.C., F.C.S.

As many articles have appeared in the scientific journals relating to the "periodic law," I feel justified in giving a short *resumé* of the papers connected with this law which were published by me long before M. Mendeljeff had printed anything upon the subject.

In a paper (CHEMICAL NEWS, vol. x., p. 59) I gave a list of all the then known elements in the order of atomic weight, which was the first ever published. Another table was appended giving a horizontal arrangement of the more important elements, also in order of atomic weight, with blanks corresponding to some of the missing members of various groups. Thus, in the trivalent group, commencing with boron, there was a blank next below zinc, since filled by gallium, and another blank immediately below cadmium, since filled by indium. It was also pointed out that in the group containing carbon, silicon, titanium, and tin, there was an element wanting having an atomic weight of 73, being, in fact, the same missing element which M. Mendeljeff has recently predicted under the name of eka-silicium.

In an appendix to this paper (CHEMICAL NEWS, vol. x., p. 94) I announce the existence of a simple relation or law among the elements when arranged in the natural order of their atomic weights to the effect that the eighth element, starting from a given one, was a sort of repetition of the first, or that elements belonging to the same group stood to each other in a relation similar to that between the extremes of one or more octaves in music. This was accompanied by a horizontal grouping arrangement.

In CHEMICAL NEWS, vol. xii., pp. 83 and 94, I published a full horizontal arrangement of the elements in order of atomic weight, and proposed to designate the simple relation existing between them by the provisional term "law of octaves." This law has since been called by M. Mendeljeff the "periodic law."

On March 1, 1866, I read a paper on this periodic law before the Chemical Society, and a notice of this appeared in the CHEMICAL NEWS, vol. xiii., p. 113, and also in many other journals. In the CHEMICAL NEWS, vol. xiii., p. 130, I wrote as follows:—"I have endeavoured to describe relations actually subsisting among the atomic weights of the elements at present known, but am far from thinking that the discovery of new elements (or the revision of the atomic weights of those already known) will upset for any length of time the existence of a simple relation among the elements when arranged in the order of their atomic weights. The fact that such a simple relation exists now affords a strong presumptive proof that it will always continue to exist, even should hundreds of new elements be discovered."

Years afterwards the brilliant researches of Roscoe showed that the atomic weight of vanadium was 51·2, instead of 137. This reduction in the atomic weight of vanadium at once placed that metal in the same line with the phosphorus group, thereby confirming the periodic law.

It may also be stated that in the CHEMICAL NEWS, vol. x., p. 95, I predicted that the atomic weight of indium might "prove to be identical, or nearly so, with those of zinc or cadmium."

In conclusion I claim to have been the first to publish a list of the elements in the order of their atomic weight, and also the first to describe the periodic law, showing the existence of a simple relation between them when so arranged. I have applied this periodic law to the following among other subjects:—

1. Prediction of the atomic weights of missing elements, such as the missing element of the carbon group = 73, since termed eka-silicium by M. Mendeljeff.

2. Predicting the atomic weight of an element whose atomic weight was then unknown, viz., that of indium,

3. Selection of Cannizzaro's atomic weights, instead of those of Gerhardt, or the old system, which do not show a periodic law (CHEMICAL NEWS, vol. xiii., p. 113).

4. Predicting that the revision of atomic weights, or the discovery of new elements, would not upset the harmony of the law—since illustrated by the case of vanadium.

5. Explaining the existence of numerical relations between the atomic weights (CHEMICAL NEWS, vol. xiii., p. 130).

6. Where two atomic weights were assigned to the same element, selecting that most in accordance with the periodic law; for instance, taking the atomic weight of beryllium as 9·4 instead of 14.

7. Grouping certain elements so as to conform with the periodic law instead of adopting the ordinary groups. Thus, mercury was placed with the magnesium group, thallium with the aluminium group, and lead with the carbon group (CHEMICAL NEWS, xiii., 113). Tellurium, on the other hand, I have always placed above iodine, from a conviction that its atomic weight may ultimately prove to be less than that of iodine.

8. Relation of the periodic law to physical properties—showing that similar terms taken from different groups, such as oxygen and nitrogen, or sulphur and phosphorus, frequently bear more physical resemblance to each other than they do to the remaining members of the same chemical group (CHEMICAL NEWS, x., 60.)

Laboratory, 9, Mincing Lane, London, E.C.,
August 18, 1878.

ON THE ORIGIN OF ELEMENTARY SUBSTANCES, AND ON SOME NEW RELATIONS OF THE ATOMIC WEIGHTS.*

(Concluded from p. 99).

By HENRY WILDE.

WE have seen that the quantivalence of most of the members of the preceding groups Hn, H_6n, is in some way correlated or dependent on the construction of the typical molecules at the head of each series; but in the series H_7n the only element which is known to be septivalent is manganese; but the relation which this metal has to the iron group, and bearing in mind that the determination of the highest quantivalence of elements is limited by the knowledge of chemists at particular times, and is only arrived at after much research, the septivalency of manganese indicate a much higher quantivalence for the other members of the series H_7n than has up to this time been accorded to them.

I have hesitated to introduce hypothetical elements alternating with the iron, palladium, and platinum groups, as the regular sequence of elementary forms is broken by varieties, and from the density of the typical molecule H_7, it may be that the members of this series are limited to those shown in the table. The density of the typical molecule H_6n may also explain the absence of members alternating with Cr, Mo, and W, and I have therefore only introduced one hypothetical element in this series, the analogue of Cr with the atomic weight = 144.

Considering how nearly the numbers representing the molecular constitution and atomic weights o the members in homologous positions in the higher groups approximate, the idea occurs that the subsequent condensations of these higher groups are in some way influenced or determined by the antecedent condensation of homologous members of the lower groups, and may be the cause of the departure in the higher groups from the simple ratios and multiple relations observed amongst the elements of the series Hn and H_2n. Such perturbations would appear to be similar to those which the planetary bodies exercise on each other to produce modifications in the forms of their orbits, but I leave this question to the further consideration of physicists and astronomers.

The complete parallelism of the halogens and oxygens to each other, and their intensely electro-negative character, point irresistibly to the conclusion that at one period of their history these elements existed in a state of isolation from all the others. How, and under what conditions, they acquired their electro-negative properties can in the present state of knowledge be only a matter of conjecture; but it may be conceived that these elements may have existed originally in the form of a zone or zones revolving within the moon's orbit, but high above the incandescent terrestrial surface—probably before the lunar substance changed from the annular to the globular form. These intra-lunar zones may have gradually acquired their electro-negative properties by lunar and terrestrial induction, and by the loss of their primitive heat by radiation into space. Their orbits being too near the earth to permit the zones to assume the spheroidal form, they would upon rupture become incorporated with the positive terrestrial elements, and remain dissociated till the temperature of the mass was sufficiently reduced to enable chemical combination to take place. If Draper's discovery of oxygen in the sun be confirmed, the hypothesis of the existence of an intra-mercurial zone of negative elements which subsequently united with the solar positive elements is at least as probable as the assumption of an intra mercurial planet which has recently been discussed by astronomers. May not the sudden increase in the brightness of variable stars like T Coronæ, Nova Ophiuchi, 1848, and Nova Cygni, 1876, be due to the intense heat generated by the union of zones of negative elements with the central bodies round which they revolve, or by the condensation of lower into higher forms of elementary species?

All the positive forms of $H2n$, except glucinum and lead, are well ascertained solar elements, and the remarkable relations which the members of this group have to those of Hn render it highly probable that, besides sodium and copper, other members of Hn are present in the solar atmosphere. From the fact that aluminum, titanium, chromium, and the irons are solar species, higher forms of these elements may also be expected to be found in the sun.

The numerical relations of the atomic weights to which I have directed attention, and the brief outline of a theory of the origin of elementary species which I have founded upon them, give new force to the doctrine of the transmutable nature of elementary substances. But when the synthetical formation of organic compounds is regarded as the greatest triumph of modern chemical science, the problem of building up the higher elements from the lower may well be deemed insoluble, as they have been formed under cosmical conditions of which we have little or no acquaintance. Very different, however, is the aspect of the problem of resolving the higher elements of each series into their respective types or into hydrogen. For just as by the application of heat, the higher members of homologous series are resolved, through their lower members, into their ultimates, so may it be expected that the elements themselves will, in their turn, give way to more powerful instruments of analysis.

When it is considered, that through the investigations of Dumas, Cooke, Odling, Mendeleeff, and others, nearly all the mathematical relations of the atomic weights to each other have been unfolded during the brief interval of thirty years, so that but few steps are now required to render the natural classification of the elements complete, the resolution of elementary species into their primordial ultimates would not appear to be far off.

* A Paper read before the Manchester Literary and Philosophical Society, April 30, 1878.

	+ Hn —	+ H2n —	H3n	H4n	H5n	H6n	H7n
1.							
2.	Li = 7	Gl = 8	C = 12	— = 16	B = 10	— = 18	N = 14
3.	Na = 23 F = 19	Mg = 24 O = 16	Al = 27	— = 32	P = 30	— = 36	Si = 35
4.	K = 39 Cl = 35	Ca = 40 S = 32	— = 42	Ti = 48	V = 50	Cr = 54	Fe = 56 56
							Mn = 56 55
							Ni = 56 58
							Co = 56 58
5.	Cu = 62	Zn = 64	— = 69	— = 72	As = 75		
6.	Rb = 85 Br = 81	Sr = 88 Sr = 80	Ga = 96	Zr = 92	Nb = 95	Mo = 96	
7.	Ag = 108	Cd = 112	Y = 123	Sn = 116	Sb = 120		Pd = 105 106
							Rh = 105 105
							Ru = 105 105
							Da = 105 —
8.	Cs = 131 I = 127	Ba = 136 Te = 128	In = 150	La = 140	— = 140	— = 144	
9.	— = 154	— = 160	E = 177	— = 165	— = 165		
10.	— = 177	— = 184	Tl = 204	D = 188	Ta = 185	W = 186	Au = 196 196
							Pt = 196 197
							Ir = 196 197
							Os = 196 198
11.	Hg = 200	Pb = 208	Th = 231	U = 240	Bi = 210		

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

No. VII.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(Concluded from p. 95.)

(4.) *Analysis of a Remarkable Iron Slag.* By J. R. SANTOS.

A slag labelled "artificial obsidian—an accidental product from a puddling furnace at Herbert's Park Iron Works of David Jones and Sons, Bilston, Staffordshire—July, 1870," presented a jet black colour, was opaque in the thinnest splinters, of unusually high lustre between vitreous and pseudo-metallic, reflecting like a mirror the images of surrounding objects; with perfect conchoidal fracture and knife-like splintery edges; sp. gr. = 2·89, and hardness = nearly 7. It afforded on analysis—

Silica	47·67
Alumina	26·36
Ferrous oxide	21·99
Cupric oxide..	0·19
Lime	0·79
Potassium monoxide	1·71
Sodium monoxide	1·12
	99·83

These figures lead approximately to the formula of the di-silicate, $Al_4Fe_3Si_6O_{21}$, corresponding to $H_6Si_2O_7$. In composition, as in physical properties, this is quite unlike any ordinary puddling-furnace slag. The intensely black colour and complete opacity are specially remarkable in view of the low percentage of iron.

(5.) *Reduction of Magnesium from its Oxide by Metallic Aluminium, and Production of Artificial Spinelle.* By JAS. H. S. AUMANN, of Tazewell Co., Virginia.

Experiments of my own* having shown that the oxides of barium, strontium, and calcium may be partially reduced by heating to a very high temperature along with metallic aluminium, the reduced metals being volatilised, it suggested itself to try a like experiment with magnesium oxide, which seemed likely to be more easily acted on. This has been done by Mr. Aumann.

He packed 25·46 grms. of pure and freshly ignited magnesia in a crucible of hard carbon, imbedding in the centre a lump of aluminium representing 8·7 grms. of pure metal covered with a plate of the same carbon, and enclosed the crucible in a larger one of plumbago ware, filling the space between the two with well rammed lamp-black. Luting on the cover of the blacklead crucible, it was exposed for six hours to the highest temperature of a wind-furnace with coal-gas retort carbon as fuel. On opening the inner crucible after cooling, the magnesia was found much compacted together and hardened, but could be detached from the remaining rounded piece of aluminium. Shining specks could be seen on various parts of the mass, especially on the outside surface of the metallic regulus, which specks appeared under low microscopic power as minute crystals.

The whole of the aluminium, of the magnesia, and of the inner crucible and cover were now separately treated with moderately strong hot hydrochloric acid, and the solutions, after the action of the acid had ceased, were filtered. The solutions were mixed together, and in a definite fraction of the liquid aluminium and magnesium were quantitatively determined. The greyish residue left on the filters from the first two solutions was dried, ignited in a stream of oxygen to burn off some specks of carbon, and on being examined with the microscope was found to consist of minute, colourless, transparent crystals of two kinds—the one being thin elongated scales, hexagonal or the same with modified angles, quite like those I had formerly obtained by heating aluminium with sodium carbonate,* and consisting of pure alumina; the other, regular octahedra, which scratched glass readily, and on fusion with acid sodium sulphate yielded (from analysis of 0·33 grm.):—

Magnesia	28·99
Alumina	70·81
	99·80

giving the ratio $MgO : Al_2O_3 = 725 : 689$; so that it was evident that these little crystals were artificial spinelle, $MgAl_2O_4$. The examination of the crystalline residues, taken along with the results of the determination of aluminium and magnesium in the original hydrochloric acid solutions, showed that a little magnesium had disappeared, volatilised undoubtedly on reduction by the aluminium. Altogether, from the materials taken, 1·040 grms. of magnesium had been reduced and volatilised, 0·771 grm. of spinelle, and 1·024 grms. of crystalline alumina had been formed.

(6.) *Analysis of Tabasheer from Sumatra.* By JAS. H. S. AUMANN.

A specimen† of genuine tabasheer, the siliceous con-

* *Chem. Soc. Journ.*, October, 1876, p. 354.

* *Chem. Soc. Journ.*, October, 1876, p. 350.

† Obtained from the Dutch Commission at the Philadelphia Exhibition of 1876, out of the very interesting collection of raw products from the Dutch East Indies.

cretion from joints of bamboo-cane, from Palembang, in Sumatra, presented the appearance of irregularly shaped fragments, from the size of a pea to that of half a walnut, generally bluish white in colour, some bits dark smoke-grey or brownish, easily broken between the fingers, finely porous, and strongly adherent to the tongue. Sp. gr. in mass, including air in the pores, equals about 0·5; after pulverisation and boiling in water to expel air, equals 1·96. Some of the whitest pieces picked out yielded on analysis—

Silica	94·196
Ferric oxide	0·098
Lime	0·125
Sodium monoxide	0·596
Potassium monoxide	0·016
Ammonia	distinct traces
Organic matter	0·221
Water	4·057
	99·309

The silica was easily soluble in solution of potassium or sodium hydrate. Of the water present 2·726 per cent was given off below 150° C., the remainder only on ignition.

This analysis, compared with that of Rost van Tonningen* of tabasheer from Java, represents less water, and greater freedom from any other constituents than silica and water. The difference as regards the quantity of alkaline metals present is very marked. He obtained—

Silica	86·387
Ferric oxide	0·424
Lime	0·244
Potassium monoxide	4·806
Organic matter	0·507
Water	7·632
	100·000

(7.) *Analysis of Precious Garnet from the Cape of Good Hope.* By Chas. Knap, jun., of Washington, D.C.

Garnet fragments, said to be from the Cape of Good Hope, and sold by the pound, under the name "Cape rubies," for jeweller's use, presented themselves of fine deep red colour; clear, and for the most part free from flaws; of an average size, not exceeding about 0·2 or 0·3 grm. in weight; irregular in shape, sometimes exhibiting water-worn, rounded surfaces; very rarely any distinguishable crystal faces; for the most part splintery and conchoidal surfaces of fracture. Sp. gr. = 3·86. Analysis gave—

Silica	39·06
Alumina	21·02
Ferric oxide	2·69
Ferrous oxide	18·70
Manganous oxide	0·58
Magnesia	12·09
Lime	5·02
	99·16

Giving the ratio $M''O : R_2'''O_3 : SiO_2 = 660 : 221 : 651$, and the usual ortho-silicate formula, $M_3''R_2'''Si_3O_{12}$.

(8.) *On the Chemical Character of "Silaonite" from Guanajuato, Mexico.* By H. D. Bruns, of New Orleans, La.

In the journal *La Republica*, of Guanajuato, No. for December 25, 1873,† V. Fernandez and S. Navia described as a new mineral species a selenide of bismuth found with guanajuatite in the mine of Santa Catarina, and on the basis of an incomplete analysis of confessedly impure material attributed to it the formula Bi_3Se. The improbability of this formula suggests itself at once, since it assumes the presence of an odd number of perissad atoms; and in a little notice of the composition of guanajuatite‡ I have alluded to the possibility of a mechanical mixture of this species (Bi_2Se_3) with native bismuth having formed the material described by Fernandez. Mr. E. S. Dana, of Yale College, has been kind enough to furnish me with an authentic specimen of the so-called silaonite, received by him directly from Senor Fernandez, and also with copies of *La Republica* containing both of the papers of the latter, and Mr. Bruns has examined the mineral in question with a view to ascertain whether it contains any free metallic bismuth in admixture or not.

The more compact portions of the specimen agreed as to appearance and physical properties with the description given by Fernandez, and also corresponded quite well to the supposition of an intimate mixture of Guanajuatite and metallic bismuth. On parts of the surface and in some little cavities a yellowish white powder was observable. A portion of this white powder was collected apart (*a*), and a portion of the thoroughly compact mineral, with distinct metallic lustre (*b*), free from the former; each of these was finely pulverised. A specimen of Guanajuatite, part of that received from Senor Bárcena, of Mexico, and analysed by me, was also reduced to a fine powder (*c*), as was finally a specimen of metallic bismuth (*d*). Strong nitric acid acted readily upon all of these, but it was found that by gradually increased dilution acid could be obtained which would not sensibly affect the bismuth selenide, while still attacking metallic bismuth. With acid containing 1 per cent of real HNO_3, left in contact with the above specimens for one, three, and six days respectively, shaking from time to time, filtering off, and testing with hydro-sulphuric acid, the following results were obtained:—

(*a*) Well marked reaction, dark brown, after even one day.
(*b*) Ditto.
(*c*) No reaction, even after six days.
(*d*) Well marked reaction, as for (*a*) and (*b*), even after one day.

On pushing the dilution even much further, as to 1-15th per cent, the same results were still obtained in each case.

There seems, therefore, sufficient reason for believing that the so-called silaonite is but a mixture, and not a distinct mineral species. It is to be noted that the results of the analysis given by Fernandez are not accurately represented by his formula, Bi_3Se, the atomic ratio of Bi : Se being 1665 : 621 or 2·68 : 1, and this he himself explains by assuming the presence of nearly 5 per cent of Guanajuatite. This latter species is in all probability the sole source of the selenium, and the surplus bismuth is present chiefly as native metal, but also in the white powder on the surface as carbonate and hydrate; which may have contributed to vitiate the analysis, since it shows the presence of foreign matter—gangue, &c.—to the extent of 20 per cent.

University of Virginia,
July 24, 1878.

* Quoted in *Jahresberichte*, 1860, S. 531.
† Quoted in *Am. Journ. Sci.*, April, 1877, p. 319.
‡ *Am. Journ. Sci.*, April, 1878, p. 296.

THE HISTORY OF ROTHAMSTED FARM.

The founder of the Rothamsted Experimental Station is Mr. John Bennet Lawes, who began his experiments on different kinds of manures, natural and artificial, soon after entering into possession of his ancestral property at Rothamsted in 1834. Rothamsted is a small village in Hertfordshire, near Harpenden, about twenty-five miles from London. His first experiments were tried in pots; but Mr. Lawes very soon transferred his labours to the field, where, by applying neutral phosphate of lime to his crops, he obtained most striking results—so much so that they led to more extensive trials in 1840 and the following years. It was not, however, until 1843 that experiments in the open field were carried out upon anything like a systematic plan. The foundation of the Rothamsted Experimental Station, which has become famous wherever

scientific agriculture is practised, may be said to date from this time.

The station has always been entirely disconnected from any external organisation, and has been maintained solely at the cost of Mr. Lawes, who has, further, set aside the sum of £100,000 and certain pieces of land for the continuance of the investigations after his death. In 1854-55 a new laboratory was built by public subscription amongst the farmers of England, and presented to Mr. Lawes in the latter year.

In June, 1843, Dr. Gilbert became associated with Mr. Lawes, and has had the direction of his laboratory ever since. The staff, which was at first very small, gradually increased, until within the last four-and-twenty years one, two, and even three head chemists have been employed, besides two or three general assistants, whose chief occupation it is to superintend the field experiments; that is to say, the making of the manures, the measurement of the plots, the application of the manures, and the harvesting of the crops. They also take part in the selection and preservation of samples for analysis or as museum specimens. They also superintend any experiments made with live stock. The museum specimens, which now amount to over 25,000 samples, consist chiefly of experimentally grown produce, animal products, ashes, and soils. A botanical assistant is also occasionally employed to assist one of the general assistants, who, under ordinary circumstances, undertakes this kind of work.

Two or three computers are also employed in calculating and tabulating the results obtained in the field and laboratory.

In addition to the work done in the laboratory by the permanent staff, Mr. R. Richter, of Berlin, has also been almost entirely occupied with the analysis of samples sent from Rothamsted; besides which, chemical assistance is frequently engaged in London. As may readily be supposed, the work done also involves the employment of a variable number of agricultural labourers and laboratory men.

The experiments carried on at Rothamsted may be divided into two classes—experiments on vegetation and experiments on animals. The first class includes experiments in growing the most important rotation crops separately year after year for many years on the same land either without manure at all, with farmyard manure, or with a great variety of chemical manures, the same kind of manure being, as a rule, used year after year on the same plot. Experiments on the rotation of crops with different manures have also been made, not only at Rothamsted, but in other localities where the soil is different. Some of these experiments have been carried on without intermission for five and twenty years.

Samples of all these experimental crops have been taken and brought to the laboratory, one portion being partially dried and preserved for future reference if necessary. The amount of ash in the remaining portion is then determined, one part being immediately analysed, and the rest preserved for future analysis. In a large proportion of the samples the amount of nitrogen is also determined. In the case of cereals, the influence of season and manuring on the yield of the different mill products has also been determined. With beetroot the amount of sugar contained in the roots has also been polariscopically determined.

Another important branch of this section is the mechanical and chemical analysis of the soils of the experimental plots, from time to time the samples being taken at depths varying from 9 to 54 inches.

Continual analyses of the rainfall and drainage-water have also been made almost from the very first. Experiments on the amount of water transpired by plants during their growth have given some very instructive results. Observations of a botanical nature have not been neglected, such, for instance, as the root, stem, and leaf development of different plants under varying conditions, the proportion of stubble to crop, &c.

Experiments were made for several years to determine whether plants assimilate free or uncombined nitrogen, and several collateral points. The experiments on animals have been made at intervals since 1847, with a view of determining the amount and kind of food consumed in relation to a given weight in a given time; the amount and kind of food necessary to produce a certain increase of weight in a given time; the relative development of the different parts of an animal under varying conditions, and a number of other collateral points of great interest. The rigid manner in which some of these experiments were conducted may be judged of by the following episode in the life of a pig that formed a subject of investigation:—

Individual male pigs were experimented upon for periods of three, five, and ten days respectively. Each pig was kept in a frame which prevented him from turning round. The bottom of his stye was made of zinc with an outlet for the liquid to run off into a bottle, and it was watched night and day, the voidings being carefully collected as soon as passed, which could be easily done as the animal never passed either fæces or urine without getting up, in doing which he rang a bell and attracted the notice of an attendant, who immediately collected the deposit. The comparative characters of animal and vegetable food in human dietaries were also investigated, but we trust that the subjects of these experiments were not subjected to the same restrictions as the pig.

In conjunction with Prof. Way an extensive investigation into the application of town sewage to different crops was also undertaken. The chemistry of the malting process and the comparative feeding value of barley and malt were also investigated.

The above interesting details about the experiments made at Rothamsted are taken from a statement which precedes the yearly account of the work done on that farm for the year 1877, and published in May last. It was originally drawn up in answer to a circular letter issued by a committee appointed to arrange for the commemoration of the twenty-fifth anniversary of the establishment of the First Experimental Station, at Möckern, in Germany, which was held at Leipzig in September last. A valuable list of the titles of all papers hitherto published in connection with experiments carried on at Rothamsted, with full references to the journals in which they appeared, is appended to this report.

NOTICES OF BOOKS.

Elements of Chemistry, Theoretical and Practical. By WILLIAM ALLEN MILLER, M.D., &c. Revised by CHARLES E. GROVES, Sec. I.C., F.C.S., &c. Part II., Inorganic Chemistry. Sixth Edition, with additions, London: Longmans and Co., 1878.

THE last edition of Part II. of Miller's "Elements of Chemistry" was published in the beginning of 1874, barely three years and a half ago, and the publishers have shown commendable promptitude in presenting the public with a sixth edition in so short a space of time. The present issue, which has been enlarged by some fifty pages, has been entrusted for revision to Mr. C. E. Groves, who, it will be remembered, assisted Professor McLeod in preparing the fifth edition.

Since 1874, beyond the discovery of gallium and the liquefaction of hydrogen, nitrogen, and oxygen, there has been but little done in the sadly neglected domain of inorganic chemistry. It really would seem that our rising chemists occupy themselves less and less every year with researches in inorganic chemistry, except there is something tangible in the pecuniary sense hanging to them. We mean such researches as those of M. Lecoq de Boisbaudran and MM. Cailletet and Pictet, or, in our own country, those of Professor Roscoe on vanadium, and

of Sir B. C. Brodie on the electrolysis of carbonic dioxide. A glance at any chemical periodical will show this at once, although England and America can lay claim to the privilege of a more extended cultivation of this branch of chemistry than either Germany or France. It is no doubt a proud day for a student when he has succeeded in squeezing one or more additional atoms of hydrogen or nitrogen into some almost unknown organic compound, but when so many simple every-day facts are crying out loudly for investigation it seems to us to be a misapplication of mental energy. We know, or at any rate we say we know, all about the constitution of meta-nitro-benzene-sulphonic acid, but we are utterly ignorant of what really goes on when iron rusts in damp air. To use Dr. E. J. Mills's words we would suggest to those students who are on the look out for subjects of investigation that their time would be more profitably employed in examining the commonest definite equations than in trying to find out the position of the third bromine atom in tribromobenzol.

Mr. Groves gives us excellent accounts of the most recent improvements in metallurgical and technological chemistry, thus preserving the practical character which Miller's "Elements" always possessed. Theory, however, has not been neglected, the bearing of the discovery of gallium (which is fully described in its proper place) on the periodic law of Newlands and Mendeljeff being fully explained. Strangely enough nothing is said about the liquefaction of hydrogen, nitrogen, and oxygen by MM. Cailletet and Pictet. Davyum is also described, as well as hydroxylamin and a number of other recently discovered bodies.

Mr. Groves has followed Professor McLeod's example in frequently giving us the constitutional formulæ of compounds suggested by Dr. Frankland. These views of the constitution of bodies, ingenious as they are, are far from being universally adopted in this country, and are entirely ignored on the Continent. It seems, therefore, to have been a pity to occupy valuable space with them; it would, in our opinion, have been much wiser and humbler to have confessed our ignorance on this important subject by using empirical formulæ. We are glad to see that Mr. Groves also follows the good example set by Prof. McLeod in not giving us those fertile sources of misprints in books and headaches in students—the Ho's, Ko's, and Nao's of the College of Chemistry.

Very little change has been made in the form of the book, indeed very little change was needed. The side-headings have been printed in bolder type, which with the cross-headings at the top of the page greatly facilitate reference. The references to recent researches are numerous and in most cases copious, and their dates have also been introduced in numerous instances. The index, which in all former editions has been very full, has now been made larger still, having been increased from eighteen to twenty-six pages. Both students and teachers will welcome the re-appearance of so old a friend.

Practical Chemistry for Medical Students Specially Arranged for the M.B. Course. By M. M. PATTISON MUIR, F.R.S.E., Prælector in Chemistry, Gonville and Caius College, Cambridge. London: Macmillan and Co., 1878.

MR. MUIR'S little manual is a veritable *multum in parvo*, containing in about fifty small octavo pages all that it is necessary for a medical student to know in the way of quantitative analysis for passing the ordinary M.B. examinations. We must cordially endorse the author's opinion that the text-books which are at the present day put into the hands of the medical student frequently fail by attempting to teach too much; the consequence is that he loses half his time in separating the wheat from the chaff, the necessary from the optional. For this reason Mr. Muir gives explicit instructions for the testing and qualitative analysis of simple salts, containing one acid radical and one base, nothing whatever being said on the more or less difficult separation of metals and acids. One peculiar feature of this little book is the table giving instructions for the detection of about a dozen of the organic acids which the medical student is most likely to meet with in his daily work. There is also a short table giving easy tests for the common alkaloids. The book may be used with advantage by all chemical students.

The Outlines of Natural Philosophy for Young Children. By E. J. HOUSTON, A.M., Professor of Natural Philosophy in the Central High School, Philadelphia. Philadelphia: Claxton and Co., 1878.

PROF. HOUSTON'S little manual is decidedly a step in the wrong direction. We had really thought that the wicked system of conveying instruction by catechisms had been long ago abandoned by all thinking teachers but this, and we are truly surprised to find that it still exists in America of all places in the world, where the modern methods of science-teaching are in many respects far beyond our own. Judicious and continual questioning must necessarily be the foundation stone of all scientific teaching, but both question and answer must necessarily be different in the case of almost every individual pupil. One child, for instance, will understand the drift of a teacher's question, and will show by his answer that he has already made that particular fact or question his own, while his neighbour, who may possibly be the more intelligent of the two, will return an answer which very plainly shows that he only has a very dim notion of what his master is talking about. Half an hour's visit to the first Board School will prove this assertion more fully than columns of writing. How is the book to be used? Are the answers to be learned off by heart and repeated as each question is asked, as in the bad old days of Pinnock, or is the book to be read aloud? In either case it affords a speedy fulfilment of Dr. Playfair's phophecy in the House of Commons in his speech on Sir John Lubbock's motion to render elementary science compulsory in Board Schools, which was to the effect that children could be made parrots with respect to magnets and steam-engines as well as with nouns and promontories.

CORRESPONDENCE.

PRINCIPLES OF COMMERCIAL CHEMISTRY.

To the Editor of the Chemical News.

SIR,—Your correspondent "In a Fog" may be a very clever theoretical chemist, but I doubt whether he knows much about "Commercial Chemistry;" nor does he himself, it seems, believe in his professed ignorance, or why should he argue a question which he states he knows nothing about?

All "good grey" sulphate ammonia contains 24·25 to 24·75 per cent of ammonia, except such lots as are allowed to leave the manufacturer's works in an *unmerchantable* condition, and these are very few, as they are liable to provoke heavy claims for loss in weight, &c. White sulphate only differs in so far that its analysis may on the average verge nearer the higher point, while 25 per cent, as stated by your correspondent, is the exception rather than the rule. To bring the sulphate ammonia up to 25 or 25·25 per cent it would be necessary either to allow it to be for a long time in the store-room or to dry it in a kiln, as in the States: the former means would require the manufacturer to provide ample store-room, and also put him to the inconvenience of having constantly a considerable amount of his working capital locked up, and the latter considerable labour and expense. It (the

kiln-drying) may suit the American sulphate manufacturers making shipments to Europe, when it has to remain in the packages for a much longer period than any English-made sulphate ammonia is required to. Another point in favour of guaranteeing only 24 per cent of ammonia is, that such a standard is easily attained, and thus disputes are rendered much less frequent than they would be with 25 per cent as the standard. In commerce this is a very important feature.

And in contradiction to your correspondent's assertion higher prices *are* obtained for the American kiln-dried sulphate, white or grey, than for English, on account of the higher percentage of the former.

The difference between white and grey sulphate is only small if the two be equally dry. The former is washed in its own liquor, and a purer acid being used than for the latter; but on account of the superior quality of the grey now made, consumers will not pay such a price for white as will induce manufacturers to produce it specially.

Your correspondent's assertion that most of the *white* sulphate is produced and sold by managers of Corporation gas-works is hardly correct. It is almost entirely produced by private firms, not one-hundredth part being made at gas-works.—I am, &c.,

J. H.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 7, July 22, 1878.

Composition of the Milk of the Cow-tree (*Brosimum galactodendron*).—M. Boussingault.—One hundred parts of the solids present in this milky juice contain—

Wax and fatty matters	84·10
Inverted sugar	2·00
Sugar capable of inversion	1·40
Gum readily saccharifiable	3·15
Casein and albumen	4·00
Alkaline ash, phosphates	1·10
Non-azotised substances not determined ..	4·25
	100·00

The juice in its original state contains 58 per cent of water and 42 of solids. Hence it resembles in its composition cream rather than milk. The fatty matters are easily resolved into fatty acids and glycerin.

Observations on the Discovery of a New Earth belonging to the Cerium Group, announced by Prof. Lawrence Smith.—C. Marignac.—The author does not yet see any sufficient reason for distinguishing the earth in question from terbia. It cannot in any case be confounded with the earth which the author and M. Soret consider as probably present in gadolinite, and which has been provisionally designated as X. Prof. Lawrence Smith considers his new base as forming part of the cerium group, which would indubitably remove it from terbia. But he takes, as distinctive character of this group, the fact that these earths are precipitated from their solutions by a saturated solution of potassic sulphate. This character is not very precise, as it depends on the degree of concentration of the liquids. Hitherto it has been admitted that the distinctive character of the two groups of earths consists in the circumstance that those of the cerium group form with potassic sulphate double salts completely insoluble in a solution of potassium sulphate. But the author finds that the sulphate of Prof. L. Smith's earth may be re-dissolved in an excess of this solution, save traces of a residue, doubtless consisting of didymic oxide, the presence of which, easily demonstrated by the spectroscope, has been pointed out by the American chemist. It is true that the solubility is much slighter than that of yttria or erbia, but this is a characteristic of terbia, which has been long ago pointed out by M. Delafontaine.

New Process for the Analysis of Milk, showing rapidly the Butter, the Milk-sugar, and the Caseine on one and the same Sample.—A. Adam.—The operation is executed by means of a very simple apparatus, which consists essentially of a glass tube, containing about 40 c.c., fitted at its upper end with a stopper, swelling out at its middle, and drawn out at its lower part, which terminates in a glass cock. Into this apparatus are introduced, first, 10 c.c. of alcohol at 75°, containing 1-200 of its volume of caustic soda; secondly, 10 c.c. of milk, which, if not neutral, must be neutralised (and in this latter case the increase of bulk due to the presence of soda must be noted); thirdly, 12 c.c. of pure ether. The alcohol, ether, and soda may also be mixed in the proportions indicated before being used. The tube is stoppered, the contents carefully mixed up, and allowed to stand for five minutes. Almost instantaneously there are formed two distinct strata, an upper limpid layer containing all the butter, and a lower opalescent layer containing all the lactose and the casein. The lower layer is run off to about 1 centimetre. The whole is then shaken up again and let settle once more for a few minutes in order to re-unite to the principal portion the small quantity of caseous solution which collects at the base of the apparatus. The buttery solution is then run into a tared porcelain capsule. The tube is rinsed out with a little ether to collect all the fatty matter, the ether is evaporated, and the capsule is weighed. The difference gives the weight of the butter augmented by 0·01 grm., due to a little lacto-caseous matter entangled among the fat. If the residue is re-dissolved in ether, which is poured into another tared capsule and evaporated, the foreign matter remains adhering to the first capsule, and the real weight of the butter is found at once. To effect the separation and determination of the milk-sugar and the casein, the liquid first drawn off from the tube is made up with distilled water to 100 c.c., and 10 drops of acetic acid are added. The casein immediately separates in curled flocks, like the nitrate of silver. It is allowed to stand for five minutes, and poured upon a very dry filter, which is covered after every addition to prevent concentration. In this manner from 94 to 96 per cent is collected of a limpid liquid containing merely the salts of the milk, the acetate of soda, and the lactose, which is determined by means of Fehling's cupro-potassic solution. If a known volume is evaporated to dryness the weight of the milk-sugar may also be found by two weighings, one before and one after incineration, taking care to deduct from the weight obtained that of the acetic acid attached to the soda. The casein is twice or thrice washed with distilled water, and the filter containing it is strongly pressed between folds of blotting paper, so as to flatten the substance as much as possible. A few minutes suffice to dry it. The difference between the weight of the filter before and after the operation gives that of the casein. Or it may be easily detached from the filter before desiccation, and after a few minutes in the drying-stove may be weighed. All these operations are easily executed in an hour and a half, and if on commencing the process 10 c.c. of milk mixed with 2 drops of acetic acid are set to evaporate we may find in addition the weight of the dry residue, of the water, and of the ash.

Chemical Researches on the Resolution of Cyclamin into Glucose and Mannite.—M. S. de Luca.—Cyclamin, either coagulated or in an aqueous solution, if left to itself for some months is decomposed into the two substances above mentioned. It is therefore a glucoside capable of yielding two sugars.

Justus Liebig's Annalen der Chemie, Band 193, Heft 1 and 2.

Chloralid and Chloralidous Compounds. — O. Wallach.—A memoir extending to upwards of 60 pages, and not admitting of useful abstraction.

Communications from the Laboratory of the University of Halle.—These consist of a paper by W. Heintz, on benzal-diacetonamin, a memoir by E. Schmidt on methylamin, and an essay by E. Schmidt and R. Sadleben on isobutyl-formic acid.

Diphenylen-keton and Phenyl-benzoic Acid. — A Schmitz. — The author describes the behaviour of diphenylen-keton on oxidation, its conversion into phenyl-benzoic acid, the salts of the latter, the formation of nitro-phenyl-benzoic acid, and the behaviour of phenyl-benzoic acid with oxidising agents, and with hydrate of potassa at the melting-point.

Diphenic Acid.—Julius Hummel.—An account of the behaviour of diphenic acid with oxidising agents of dinitro-diphenic acid and di-amido-diphenic acid.

On Diphenylen-methan.—R. Fittig and A. Schmitz. —Diphenylen-methan, $C_{13}H_{10}$, crystallises from alcohol in perfectly colourless shining leaflets, very slightly fluorescent. The strong fluorescence observed by Berthelot and Barbier in the hydrocarbon obtained from coal-tar, and which gave occasion to the name fluoren, is due to an impurity. Diphenylen-methan is sparingly soluble in alcohol in the cold, but readily with the aid of heat, as well as in ether, benzol, and sulphide of carbon. It melts between 112° and 113°. The boiling-point is constant between 294° and 295°, though Barbier places it about 305°, and Graebe between 300° and 305°. The authors then describe diphenylen-methan picric acid, dibrom-diphenylen-methan, an apparently dimorphous substance, and dinitro-diphenylen-methan.

On Fluoranthen: a New Hydrocarbon in Coal-Tar.—R. Fittig and F. Gebhard.—Fluoranthen, $C_{15}H_{10}$, is sparingly soluble in alcohol in the cold, but readily with the aid of heat, as also in ether, sulphide of carbon, and glacial acetic acid. From a concentrated alcoholic solution it crystallises in long thin needles, but from dilute solutions in large shining colourless tables. Its melting-point is constant at 109°. It stands between phenanthren (anthracen) and pyren, and probably bears the same relation to fluoren as does phenanthren to diphenyl.

Substitution-Products of Mesitylenic Acid and their Constitution.—H. J. Schmitz.—The author undertakes to prepare those substitution-products of mesitylenic acid, in which the atoms or atomic groups to be substituted are between the two methyl-groups, in order to employ them as points of departure for the preparation of the corresponding derivatives of metaxylol, and of the hitherto unknown third trimethyl benzol.

Contributions to the Knowledge of Quinic Acid.—R. Fittig and W. F. Hillebrand.— The authors consider it scarcely doubtful that quinic acid is the monobasic pentatomic acid of hexa-hydro-benzol, C_6H_{12}, and is closely connected with pentacid quercite.

Isomeric Nitro- and Amido-Benzoic Acids, and the Formation of Chloranil from the latter. — E. Widnmann.—The author finds that on the nitration of benzoic acid by means of sulphuric acid and saltpetre, there are formed only meta-, ortho-, and para-nitro-benzoic acids, which cannot be separated in the free state, but only with the aid of their barium salts. Metanitro-benzoic acid has two distinct melting-points, which are not affected by superheating up to 205°. Ortho- and para-nitro-benzoic acid have only one melting-point. Mixtures of any two of the isomers in different proportions show occasionally definite melting-points, but which may fall below that of the most easily fusible component. The three isomeric amido-benzoic acids yield with potassium chlorate and hydrochloric acid, chloranil, and mixtures of tri- and tetra-chlorquinon. The separation of the two chlorinated quinons is not practicable by Graebe's method, because, as Stenhouse correctly maintains, tetrachlor-quinon is partially converted by sulphurous acid into trichlor-hydroquinon.

Band 192, Heft 3.

Experimental Researches on Hydrogen Peroxide. —Em. Schoene.—The author first examines the behaviour of hydrogen peroxide with the monoxides and dioxides of the alkaline-earthy metals. He considers that the mutual reaction of the peroxides of hydrogen and barium (or what amounts to the same thing, the "catalysis" of hydrogen peroxide by barium peroxide) may be explained by assuming that it consists of the following three reactions :—

I. $BaO_2+H_2O_2=BaH_2O_4$.
II. $BaH_2O_4=BaO_3+H_2O$.
III. $BaO_3+H_2O=BaO_2+O+H_2O$.

This explanation is hypothetical in the second phase, only where the formation and transit existence of a barium trioxide — not known in the free state — are assumed. Whether in reality the latter stage of oxidation is formed, or a tetroxide, as in case of potassium, is not decided. There are grades of sulphurisation corresponding to both oxides, BaS_3 formed in the dry, and BaS_4 formed in the moist way. The separate reactions do not all take place in succession; rather the decomposition of the hypothetical trioxide or tetroxide runs chiefly parallel with its formation, so that whilst one portion of the polyoxide is being decomposed, another is forming, &c. Thus this case of catalysis, like the formation of ether, is explained by a series of normal chemical reactions, partly simultaneous and partly successive.

Action of Watery Vapour upon Ignited Wood Alcohol.—J. H. Long.—The author was unable to trace any simple proportion between the volumes of carbonic acid and carbonic oxide. The quantity of charcoal has a decided influence upon the formation of carbonic acid, which regularly decreases as the charcoal is oxidised. Hence it would appear that carbonic acid is first formed by the action of watery vapour upon the charcoal, and is then reduced to carbonic oxide by the further action of the excess of carbon. As soon as the carbonic oxide thus formed comes in contact with excess of watery vapour, a third reaction sets in: $CO+H_2O=CO_2+H_2$, steam being known to be reduced by carbonic oxide.

Contributions to the Steric Law.—H. Schroeder.— The substance of this paper has already appeared in the CHEMICAL NEWS.

Separation of Antimony and Arsenic.—R. Bunsen. —The author points out as a source of error in the determinations of arsenic, that the ammonia-arseniate of magnesia retains its crystalline water a little below 100°, to the extent almost of an atom, but gives it up at temperatures between 102° and 105°. If this compound is to be used as a means of separation, it is preferably dissolved upon the filter in nitric acid, and the solution, after evaporation to dryness in a platinum crucible, is converted by heat into bibasic arseniate of magnesia, and weighed as such. Still all such determinations of arsenic cannot lay claim to an even moderately satisfactory degree of accuracy, since the ammonia-arseniate of magnesia, like the sulphate of baryta, obstinately retains salts from the precipitating liquids, and a prolonged washing with ammonia is impracticable since 30 c.c. of the latter dissolve about 1 milligramme of the precipitate. Many of the determinations of antimony as hypo-antimonic acid are also inaccurate. The temperature at which antimonic acid passes into hypo-antimonic acid, borders very closely upon that at which the latter begins to be resolved into oxygen and antimonious acid. The author, therefore, rejects these methods of determination, as well as the processes for the separation of arsenic and antimony hitherto in use, and proposes the following:

the sulphides of arsenic and antimony, while still moist, are dissolved upon the filter in an excess of solution of potassa, which must have been purified by means of alcohol. The solution, together with the concentrated washings, is introduced into a porcelain crucible, holding about 150 c.c., and a rapid current of chlorine is introduced into the liquid through a hole in the watch-glass, which serves as a cover till all the alkali is neutralised. The crucible, still covered with the watch-glass, is heated in the water-bath, and concentrated hydrochloric acid in great excess is dropped in by means of a pipette. The liquid is evaporated down to half its bulk, the loss is again made up with an equal volume of concentrated hydrochloric acid, and the liquid is again concentrated down to the half or the third, in order to expel all free chlorine. It can now be diluted to a perfectly limpid solution, by the addition of very weak hydrochloric acid, without tartaric acid, which interferes with the separation. To this solution there are now added for every decigramme of antimonic acid probably present, about 100 c.c of a recently prepared and *saturated* solution of sulphuretted hydrogen, when penta-sulphide of antimony is precipitated immediately or after a short time, according to its larger or smaller proportion. As soon as this precipitate has separated itself, the excess of sulphuretted hydrogen is immediately removed from the solution, by forcing through it a violent current of air, filtered through cotton wool. This is easily affected by means of the blast of a glass-blowing table. To prevent loss by spirting, the beaker must be kept covered with a perforated watch-glass, the air pipe entering through its aperture. In about 15 to 20 minutes the air is expelled, and the liquid becomes inodorous. The precipitate is then thrown upon a weighed filter and washed with the filter-pump, the filter being filled in succession eight or ten times with water, twice with alcohol, four times with sulphide of carbon, and finally three times with alcohol. The precipitate is dried at 110° in the salt-bath, at which temperature it remains for any length of time perfectly constant in weight. The washings even in not very experienced hands do not require more than an hour. The filtrate which contains the arsenic as arsenic acid does not retain the least trace of antimony. The antimonial precipitate may in certain cases retain quite insignificant traces of arsenic. But if after washing with water it is re-dissolved in hydrate of potassa, and the process of separation repeated, the antimony is obtained free from any trace of arsenic. The determination of arsenic in the filtrate and washings is no less simple. The collected liquid, after the addition of a few drops of chlorine, is heated on the water-bath, and treated with a prolonged current of sulphuretted hydrogen, both whilst hot and during cooling. The precipitate is allowed to settle for a day, at a gentle heat, and is then placed upon a weighed filter. If care has been taken to leave a sufficient excess of sulphuretted hydrogen in the liquid during its heating and cooling, the resultant precipitate consists of a little sulphur and arsenic penta-sulphide, without the least admixture of trisulphide. Before weighing, it is treated exactly like the antimonial precipitate. Its composition and weight are constant after drying at 110°.

Communications from the Laboratory of the University of Halle.—These consist of papers on amido-trimethyl-oxy-butyric acid, and on the products of the action of hydrocyanic acid upon hydrochlorate of diacetonamin, both by W. Heintz.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 12, July 18, 1878.

Treatment of Hydrophobia among the Arabs.—M. L. Reiche has presented the following communication to the Entomological Society of France:—"I send you the Arab remedy for hydrophobia. It consists of two species of coleoptera, of which I forward you specimens. They were given to me south of the Ouderna, by a man of the tribe of the Amernas, who possesses a dozen of them, which he preserves carefully. He gave me a detailed account of their virtues, and fully explained the manner of using them. On my return to Gabes, I spoke of this remedy to a very intelligent Arab, who affirmed that all I had heard was true; that I might read in their medical works that the *Dernona* cures madness if administered within twenty days from the bite; that the patient should take a piece of the size of a grain of wheat, in a morsel of meat. The insect is said to have very strong vesicating powers, and to increase the dose much would be dangerous to life. Its use occasions severe colic. Hence it appears to be an extremely violent remedy, which should be administered with great caution." The fragments of beetles received appear to belong to *Meloe tuccius* and *Mylabris tenebrosa*, strongly vesicating insects whose congeners are common in France. It is to be remarked that the use of the *Meloe* was recommended as far back as 1856, in a communication made to the Society by M. L. Fermaire.

No. 13, July 25, 1878.

Variations of the Intensity of Weight in One and the Same Place.—A communication made to the Academy of Sciences by M. Plantamour, on the changes in the direction of the perpendicular, has recalled the attention of physicists to the analogous observations made by M. Bouquet de la Grye, with the seismograph, and by M. d'Abbadie, with the "Nadirane." The latter remarks that the displacements of the plummet can be due to two causes only—either to a change of the position of the earth's centre of gravity, or to a removal of the superficial layers of the soil.

English Pottery at the Paris Exhibition.—M. Louis Enault.—The author considers that the ceramic art has made incontestable progress since 1867. The only possible competitor with England is France.

No. 14, August 1, 1878.

The manufacture and sale of earthenware, whether French or foreign glazed, with a layer of lead oxide melted, or imperfectly vitrified, and consequently capable of yielding lead to weak acids, is interdicted in France.

Extent and Principal Zone of the Aurora Borealis.—M. H. Fritz.—The appearance of local aurora is unfavourable to the hypothesis which places these lights among cosmic phenomena. The zone of maximum frequence and intensity of the aurora begins at Barrow's Point (lat. 72° N.), on the northern coast of America; thence it passes over lake Beoa towards Hudson's Bay, which it crosses in 60° N. lat., passing near Nain on the coast of Labrador, turning to the south of Cape Farewell, between Iceland and the Faroe islands; thence to near North Cape, round Novaya Zemlya and Cape Tscheljuskin, approaching the northern coast of Asia, in the longitude of Nischni Kolymsk, and returning thence to Point Barrow.

No. 16, August 15, 1878.

The two Institutes of Physiology and Physics at Berlin, constructed upon the plans of MM. Helmholtz and Du Bois Reymond, form an immense palace which has cost more than five million francs.

Bulletin de la Societe Chimique de Paris,
Tome 30, No. 2, July 20, 1878.

Remarks on the Constitution of Diallyl.—Louis Henry.—The author considers the most probable formula of diallyl to be—

$$\begin{array}{l} CH_2-CH=CH_2 \\ | \\ CH_2-CH=CH_2. \end{array}$$

On Starch.—F. Musculus and D. Gruber.—The following bodies are produced at the expense of starch under the influence of diastase or of dilute boiling sulphuric acid:—Soluble starch, erythrodextrin; achroodextrin, α, a compound not coloured by iodine; achroodextrins, β and γ; maltose and glucose. The authors consider starch as a polysaccharide of the formula $n(C_{12}H_{20}O_{10})$, in which the exact value of n remains to be determined.

Chemiker Zeitung.

No. 31, August 1, 1878.

Quantitative Analysis of the Products of the Prussiate of Potash Manufacture, with Remarks on the Rational Utilisation of the Residues.—A. Gawalowski.—For the examination of the finished cyanide the author recommends De Haen's method, at least in the absence of sulphides and sulphocyanides. The clear solution of the prussiate is evaporated down, ignited with sulphuric acid, the residue moistened with an alcoholic solution of nitrate of ammonia is ignited again, and dissolved in hydrochloric acid; the iron is precipitated with ammonia, washed, and ignited. The residue, minus the weight of the ash of the filter multiplied by 5·28, gives the quantity of actual ferrocyanide in the weighed sample. The products of a prussiate works are *crude salt*, containing 70 to 80 per cent of ferrocyanide, along with sulphocyanide, sulphide, and sulphate, and mechanically mixed with carbon. *Smear salt* is the residue from the evaporation of the mother-liquor of crude salt. Blue potash is a potash boiled down from the mother-liquor of smear salt, and contains 50 to 70 per cent carbonate of potash, 1 to 4 per cent ferrocyanide, and various impurities. The carbonaceous residue sometimes contains from 1 to 5 per cent of ferrocyanide.

The Elberfeld Chamber of Commerce complains that the alizarin manufacture suffers greatly from the import duty of 3 marks (3s.) per cwt. upon caustic soda.

The meeting of the Society of Swiss Naturalists took place at Berne on the 12th, 13th, and 14th of this month.

No. 32, August 8, 1878.

An explosion is announced as having happened in Kleinknecht's Chemical Works, at Brackenheim. Two men were wounded, one—the manager—severely.

Prof. Swanberg, of Upsala, the pupil, friend, and successor of Berzelius, died on the 16th of July, in his 73rd year.

At San Francisco the impure gases from cesspools, &c., are to be mixed with coal-gas and burnt in the street-lamps. In some preliminary experiments it was found that the light was not in the least injured by the admixture!

The oil of bankul-nuts (*Aleurites triloba*) is superior to colza for illuminatiug purposes.

Accordiug to Böttger, an aqueous solution of xanthogenate of potassa is an exceedingly sensitive test for salts of nickel. An intense yellow colouration—or with larger quantities a yellow precipitate—is produced, which does not disappear on the addition of a few drops of ammonia. Salts of copper yield the same colouration or precipitate with the same reagent, but the colour immediately disappears on the addition of ammonia.

MISCELLANEOUS.

Thevenot's Globules.—M. C. Thevenot, of the Société de Pharmacie, of Paris, has invented a novel form of administration of medicine, which is, we consider, most valuable for medicines which deteriorate through exposure or which are of a nauseous nature. The case in which the medicine is enclosed is both soluble and digestible. Among other advantages the inventor claims that the most volatile substances can thus be accurately dosed and preserved for an indefinite period, and that the globule, unlike the pill, does not become stale, hard, and gritty. Among the medicines which are thus administered are bromide of potassium, iodide of potassium, carbonate of iron, bromide of camphor, tar, gurana, turpentine, castor oil, reduced iron, hydrate of chloral, nitrite of amyl, &c. We have received specimens of these medicines from Messrs. H. K. Edge and Co., 34, King William St., E.C

TO CORRESPONDENTS.

Student.—The question appears to be a perfectly fair and proper one

C. Estcourt.—The name of this gentleman was omitted from the list of the Committee of Section B. of the British Association.

THE CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free, including Indices, £1

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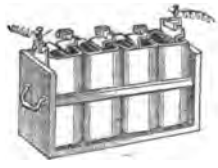

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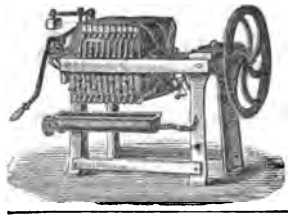

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 980.

ADDRESS TO STUDENTS.

Within a short time after the publication of the following words of advice and warning the now happily numerous chemical schools and laboratories, both public and private, which have grown up of late years in every town and city of any importance throughout the kingdom, will once more throw open their doors to all who desire to enter.

Students of chemical science may be roughly divided into two great classes—those who study from the pure love of the thing itself, and those who study from compulsion. The latter class is undoubtedly the larger of the two, and may be dismissed in a very few words. It includes the vast majority of University students who cram up a certain amount of information, more or less sound, on chemical subjects under a clever coach, just as they cram up the "Agamemnon" of Euripides, the Offices of Cicero, or the properties of the parabola, the whole of which are forgotten the very moment that they possess the precious privilege of tacking the magic letters M.A. or B.A. to their names. With such as these, most of them victims to the present system of University examinations, we have nothing to do except indeed to sympathise with them; the few words which follow must therefore be taken as addressed more especially to the first class of students—the true seekers after scientific knowledge.

When the young student—after a couple of years desultory study in the school laboratory, or perhaps in the domestic back kitchen—says to himself "I will be a chemist," and enters upon a course of serious study under a competent teacher, he is at first somewhat confused at the numerous vistas that open up before him in his daily work. He is like a child in a garden of butterflies: he does not know which to run after first; the consequence most frequently is that he runs after several at once and catches none. During his reading hours he finds so many gaps in the investigations of others, even of our most eminent workers, that he fills his note-book with "mems." of fifty different subjects for future investigation, any one of which would take half a lifetime to follow up. The great danger to an ardent student of this kind is the desire to do too much—to be too ambitious. To such as these we say—Be patient; form no resolutions for the future, and fill your note-books with "mems.," not of what you are going to do many years hence, but of what you have done to day. All these ideas about future research are only so many Will-o'-the-wisps which will lure you from your daily work, and possibly procure you the honour of being "plucked" for not being able to answer some trivial question which your be-crammed and be-coached companion—who perhaps never handled a test-tube in his life—has at his fingers' ends. There is an old French saying to the effect that if you keep the company of wolves you must howl. By a parity of reasoning, if you wish to compete with the crammed you must cram. To many of our readers this will no doubt appear singular advice, and diametrically opposed to the principles we have always advocated; but the guilt of the apparent inconsistency must lie at the door of those who control our University examinations, and who prefer book-learning to practical knowledge. The earnest student, however, has this advantage over his competitors who cram from books—he can not only follow their example, but he can make the knowledge that he gains part and parcel of his being by practical work. Leave future research to take care of itself, and concentrate all your powers on the present, and you will find that by the time you are in a position to laugh at the vagaries of examining bodies you will have been insensibly led to fall in love with some special object of research, which it will be at once your pleasure and duty to wed and live happy with for ever after, like the princes and princesses in the fairy tales. Take up the collected researches of our greatest men—Faraday or Graham for instance—and you will find them steadily pursuing a single object from the beginning to the end of their working life. Graham, perhaps, is almost a better example of this than Faraday, who from his official position was more than once obliged to take up subjects of research that were not his own. It seems a pity that the collected edition of Graham's chemical and physical researches should not be procurable by the general reader, having been printed for presentation only, but the work exists in most public libraries, and should be read by every student again and again, not so much for the scientific information contained in it, but for the sake of seeing how closely Graham followed one leading idea, from his first researches on the Absorption of Gases by Liquids to his last on the Metallic Nature of Hydrogen—of what is and how is matter composed. These two philosophers have left a greater mark upon the scientific history of their time than any half dozen of their contemporaries; but in spite of their both being D.C.L.'s of Oxford, we doubt if at any portion of their grand career they could have undergone the matriculation examination of any of our Universities without being hopelessly "plucked."

There are a couple of offshoots from the two great classes we have mentioned to whom a few words may be welcome—we mean medical and pharmaceutical students, who areapt to stray into the contrary extremes. The former looks on chemistry as a bore, and a subject to be crammed because no medical examiner has yet been found who has the knowledge or the courage to show by his questions that chemistry is as intimately related to medical science as anatomy itself. Most medical men look on chemistry as a kind of adjunct to pharmacy, a knowledge of which will prevent them from poisoning their patients or from puzzling their pharmacists by prescribing a series of incompatibles. To such as these we would put a simple question. How is it that although the chemist during the last ten years has discovered many thousands of definite compounds possessing the most multifarious chemical, physical, and presumably physiological properties, that not half a dozen of these have been applied to the relief of human suffering or the saving of human life? Is it possible, even according to the vulgar doctrine of chance, that there are no compounds lying perdu on the shelves of the chemist's laboratory that would prove as powerful weapons in the hands of the physician as chloroform, chloral, or amyl nitrite? The field open to the medical student in this direction is surely vast enough to content the hardest worker, and

Candidates for the degree of M.B. are strongly recommended by the Senate to pass the Preliminary Scientific Examination before commencing their regular medical studies; and to devote a preliminary year to preparation for it according to the following programme:—Winter Session: Experimental Physics; Chemistry (especially Inorganic); Zoology. Summer Session: Practical Chemistry (Inorganic); Botany.

Any candidate who has passed the Preliminary Scientific (M.B.) Examination, may be examined at the Honours Examination next following the Preliminary Scientific Examination at which he has passed, unless he has previously obtained an Exhibition in any one of the subjects at the First B.Sc. Examination, in which case he is not admissible to the Examination for Honours in that subject.

Candidates for Honours in Chemistry are examined in Inorganic Chemistry, treated more fully than in the Pass Examination. In addition they are examined practically in Simple Qualitative and Quantitative Analysis.

EXAMINATION IN SUBJECTS RELATING TO PUBLIC HEALTH.

A Special Examination is held once in every year in subjects relating to public health. It commences on Monday, December 9, 1879.

No candidate is admitted to this Examination unless he has passed the Second Examination for the Degree of Bachelor of Medicine in ths University at least one year previously; nor unless he shall have given notice of his intention to the Registrar at least two calendar months before the commencement of the Examination.

The Fee for this Examination is £5.

Candidates are examined in the following subjects:—

Chemistry and Microscopy, in relation to the examination of Air, Water, and Food.

Meteorology and Geology, as far as they bear on the duties of Health Officers, viz.:—General knowledge of Meteorological Conditions; Reading and Correction of Instruments. General knowledge of Soils; their Conformation and Chemical Composition.

Vital Statistics, in reference to the methods employed for determining the Health of a Community; Birth-rate; Death-rate; Disease-rate; Duration and of Expectancy of Life. Present amount of Mortality, and its causes, in different Communities.

Hygiene.—General principles of Hygiene. Special topics:—Soil. Construction of Dwellings. Conservancy of Cities. Unhealthy Trades. Supply of Food to Cities, and Examination of Food. Disposal of Sewage. Water-supply.

Medicine, in reference to the origin, spread, and method of prevention of Diseases generally, but especially those of the Epidemic class.

Sanitary Engineering, as far as regards the arrangements connected with Water-supply, Sewerage, and Ventilation. A knowledge of the reading of Plans, Sections, Scales, &c.

Sanitary Law, as far as it relates to the duties of Officer of Health. A knowledge of the powers given under the various Sanitary Acts, as defined in the Instructions issued by the Local Government Board, and of the methods of procedure in special cases.

The Examination, which is both written and practical, extends over four days.

GILCHRIST SCHOLARSHIPS.

1. A Scholarship of the value of Fifty Pounds per annum, and tenable for three years, is annually awarded to the highest among those candidates at the June Matriculation Examination who have been approved by the Principal of University Hall as fit to be received into that Institution with a view to the prosecution of their studies in University College for Graduation in one of the four Faculties of the University of London; provided that such Candidate pass either in the Honours List or in the First Division.—Particulars may be obtained on application to the Principal of University Hall, Gordon Square, W.C.

2. A similar Scholarship is annually awarded to the Candidate from the Royal Medical College, Epsom, who at the June Matriculation Examination stands highest among the Candidates approved by the Head Master of that Institution, and who passes either in the Honours List or in the First Division; on condition of his prosecuting his studies during the tenure of his Scholarship with a view to Graduation in one of the four Faculties of the University of London.—Particulars may be obtained on application to the Secretary of the Royal Medical College, 37, Soho Square, W.

3. A similar amount is annually offered to Candidates intending to pursue, at Owens College, Manchester, their studies for Graduation in one of the four Faculties of the University of London; a single Scholarship of Fifty Pounds per annum for three years being awarded to the highest of those Candidates at the June Matriculation Examination who shall have been previously approved by the Principal of Owens College, provided that he pass in the Honours Division; or, in case no Candidate should so pass, two Scholarships, each of Twenty-five Pounds per annum, being awarded to the two Candidates as aforesaid who shall stand highest in the First Division.—Particulars may be obtained on application to the Principal of Owens College, Manchester.

Particulars of the Colonial and Indian Scholarships may be obtained on application to the Secretary of the Gilchrist Educational Trust, University of London, W.

UNIVERSITY OF OXFORD.

Waynflete Professor of Chemistry.—W. Odling, M.A., F.R.S.

Professor of Mineralogy.—N. S. Maskelyne, M.A., F.R.S.

Every Student must reside in one or other of the Colleges or Halls, or in licensed lodgings, for a period of three years, passing at least two examinations in Arts, and one in either Mathematics, Natural Science, Law, Modern History, or Theology, when, if he obtain a first, second, or third class, he can take his B.A. Degree; if he do not gain such honour he has to pass a third examination in *Literis Humanioribus*.

Lectures by the Waynflete Professor on Mondays, and Thursdays at the Museum.

Lectures on Elementary Organic Chemistry will be given by the Aldrichian Demonstrator of Chemistry, Mr. W. W. Fisher, M.A., of Corpus Christi College, on Wednesdays and Saturdays, at 11 a.m.; and Lectures on Elementary Inorganic Chemistry by Mr. W. F. Donkin, M.A., of Magdalen College, on Tuesdays and Fridays, at 11 a.m.

The Laboratory of the University will be open from 10 a.m. to 4 p.m. daily, and instruction in Practical Chemistry will be given by the Aldrichian Demonstrator, and by Mr. John Watts, B.A., of Balliol College.

A Course of Practical Instruction in Organic Chemistry will be conducted by Mr. W. H. Pike, Ph.D.

The fee for students working in the Laboratory for three days in the week during the Term is £3; for students working every day, £5.

The new laboratories are nearly completed, and will probably be opened at the beginning of 1879.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other colleges, by competitive examination in Natural Science.

More detailed information may be obtained from the University Calendar; from the professors; from E. Chapman, Esq., M.A., Frewin Hall; and from the Sub-Librarian in the Radcliffe Library or the Museum.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

Jacksonian Professor of Natural and Experimental Philosophy.—J. Dewar, M.A.

Demonstrators.—J. W. Hicks, M.A., W. J. Sell, B.A., and H. J. H. Fenton.

The Student must enter at one of the Colleges, or as a Non-collegiate Student, and keep terms for three years by residence in the University. He must pass the previous examination in Classics and Mathematics, which may be done in the first or second term of residence, or, through the Oxford and Cambridge Schools Examination Board, or through the Senior Local Examinations, before commencing residence. He may then proceed to take a Degree in Arts, either continuing mathematical and classical study, and passing the ordinary examinations for B.A., or going out in one of the Honour Triposes.

The scholarships, ranging in value from £20 to £80 a year, are chiefly given for mathematical and classical proficiency. Scholarships are given for Natural Science in Trinity, St. John's, St. Peter's, Clare, Christ's, Sidney, Pembroke, Caius, and Downing Colleges; the examinations being at Easter, and in June and October.

The Chemical Laboratory of the University is open daily for the use of the Students. The Demonstrator attends daily to give instructions.

Non-collegiate Students are allowed to attend certain of the College Lectures and all the Professors' Lectures, and have the same University status and privileges as the other Students. They are under the superintendence of the Rev. R. B. Somerset, Orford House, Cambridge, from whom further information may be obtained.

The following are the Lectures on Chemistry for the ensuing Academical Year: —

MICHAELMAS TERM, 1878.

General Course, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Oct. 14.

Spectroscopic Analysis, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 1.30 p.m. Begin Oct. 16.

Analysis, by the Professor and the Demonstrators of Chemistry. Daily. Begin Oct. 8. Also at St. John's College, by Mr. Main. Begin Oct. 15. Also at Caius College, by Mr. Pattison Muir; begin Oct. 16.

Metals, by Mr. Pattison Muir. Monday, Wednesday, and Friday, at 10. Begin Oct. 14.

Physical Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Oct. 15.

Elementary Organic Chemistry, by Mr. Main, at St. John's College, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Oct. 16.

Volumetric Analysis, by a Demonstrator, on Tuesdays, Thursdays, and Saturdays, at 10 a.m. Begin Oct. 15.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin Oct. 14.

Elementary Lectures on the more important Minerals, by the Deputy Professor of Mineralogy, on Mondays, Wednesdays, and Fridays, at 1. Begin Oct. 14.

LENT TERM, 1879.

General Course continued, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Jan. 31.

Analysis, by the Professor or Demonstrators of Chemistry. Daily. Begin Jan. 21. Also at St. John's College. Begin Jan. 29. Also at Caius College Laboratory. Begin Jan. 29.

Organic Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Jan. 30.

General Course, begun by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Jan. 31.

Non-metallic Elements, by Mr. Pattison Muir, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin Feb. 1.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin Jan. 31.

EASTER TERM, 1879.

Some Special Department, by the Professor of Chemistry, on Mondays and Fridays, at 12 noon. Begin April 25.

Analysis, by the Professor or Demonstrators of Chemistry. Daily. Begin April 23. Also at St. John's College. Begin April 24. Also at Caius College. Begin April 23.

Elementary Chemistry, by the Demonstrator of Chemistry, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin April 24.

General Course concluded, by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin April 24.

Elementary Organic Chemistry and Analysis, by Mr. Pattison Muir, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin April 23.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin April 30.

Crystallography, by the Deputy Professor of Mineralogy.

UNIVERSITY OF DUBLIN.—TRINITY COLLEGE.

The Chemical Laboratory will re-open on October 1st, 1878.

The University Professor of Chemistry, Dr. Emerson Reynolds, assisted by the Demonstrator of Chemistry, Mr. Early, conducts the undermentioned Courses of Laboratory instruction:—

The First Course of Practical Chemistry.—Michaelmas Term:—Qualitative Analysis and the Use of the Spectroscope. Hilary Term: Volumetric and Simple Gravimetric Analysis. Trinity Term: Organic Preparations and Analysis.

Students can also attend the Professor's Lectures on General Chemistry, and repeat most of the experiments performed in the Theatre.

This Course terminates on the last day of June.

The Second or Advanced Course includes instruction in the higher branches of Experimental and Analytical Chemistry, and in Methods of Research. Students who take out this Course are free to devote their chief attention to the study of special departments of Chemistry as applied to Arts and Industries.

Summer Course of Practical Chemistry for Medical Students.—This Course commences on the first Monday in April and terminates on the 30th of June following. Students experiment in the Laboratory from 2 to 4 o'clock on Tuesdays, Thursdays, and Saturdays.

Special Courses.—Students can enter at any time throughout the academic year for short terms of Laboratory instruction in Medical or Pharmaceutical Chemistry, or in the Methods of Analyses of Water, Air, &c., for Sanitary Purposes.

Lectures in Medical and Pharmaceutical Chemistry.—Dr. Reynolds lectures at 2 o'clock on Tuesdays, Thursdays, and Saturdays, from the 1st of November to the 31st of March following.

All the classes are open to extra-Academic Students.

SCIENCE AND ART DEPARTMENT OF THE COMMITTEE OF COUNCIL ON EDUCATION, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

In order to place a science school or class in connection with the Science and Art Department, an approved committee, consisting of at least five well known and responsible persons, must be formed.

The following are the sciences towards instruction in which aid is given by the Science and Art Department:—Practical, Plane, and Solid Geometry; Machine Construction and Drawing; Building Construction; Naval Architecture and Drawing; Pure Mathematics; Theoretical Mechanics; Applied Mechanics; Acoustics, Light, and Heat; Magnetism and Electricity; Inorganic Chemistry; Organic Chemistry; Geology; Mineralogy; Animal Physiology; Elementary Botany; Biology, including Animal and Vegetable Morphology and Physiology; Principles of Mining; Metallurgy; Navigation; Nautical Astronomy; Steam; Physiography; Principles of Agriculture.

The aid is given in the form of—1. Public examinations, in which Queen's Prizes are awarded, held at all places complying with certain conditions; 2. Payments on results as tested by these examinations; 3. Scholarships and Exhibitions; 4. Building grants; 5. Grants towards the purchase of fittings, apparatus, &c.; 6. Supplementary grants in certain subjects, and special aid to teachers and students.

The examinations are held about the month of May under the superintendence of the local committees and local officers. The examination papers are prepared by the professional examiners in London. An evening is set apart for one or more subjects, so that the examination in each subject is simultaneous over the whole kingdom.

A packet of examination papers is sent to each local examination secretary, who opens it in the presence of the committee and candidates. The committee is held responsible that no unfair means of any description are used in working the papers, and that the rules of the Department are strictly complied with.

The examinations are of two kinds, but held together, viz.—

a. The Class examinations, of which there are two grades or stages; the first stage or elementary examination, and the second stage or advanced examination. The successful candidates in both stages are divided into 1st and 2nd class.

b. The Honours examination of a highly advanced character. In this there are also two classes.

Any person however taught may sit at any one of these examinations.

The Queen's prizes, consisting of books or instruments, are also given to all candidates who are successful in obtaining a first class in either stage of the class examinations.

The payments on results are made only on account of the instruction of students of the industrial classes, or on account of the instruction of their children. They are—£2 for a first class, and £1 for a second class, in each stage of the class examinations, and £2 and £4 for a second or first class respectively in honours. Special extra payments are made in attendance in organised Science Schools. Special payments are also made for Chemistry.

There are also two forms of scholarship in connection with elementary schools.

a. In the Elementary School Scholarship £5 are granted to the managers of any elementary school for the support of a deserving pupil selected by competition, if they undertake to support him for a year and subscribe £5 for that purpose. The payment of £5 by the Science and Art Department is conditional on the scholar passing in some branch of science at the next May examination.

b. In the Science and Art Scholarship, which is of a more advanced character, a similar contribution of £5 is required on the part of the locality, and a grant of £10 is made by the Department towards the maintenance, for one year, of the most deserving pupil or pupils in elementary schools who have passed certain examinations in science and in drawing.

In both these cases the scholar must be from twelve to sixteen years of age, and one scholarship is allowed per 100 pupils in the shool.

There are also two forms of Exhibitions. These are:—

a. Local Exhibitions to enable students to complete their education at some college or school where scientific instruction of an advanced character may be obtained. Grants of £25 per annum, for one, two, or three years are made for this purpose when the locality raises a like sum by voluntary subscriptions. And if the student attend a State School, such as the Royal School of Mines in London, the Royal College of Chemistry in London, or Royal College of Science in Ireland, the fees are remitted.

b. Royal Exhibitions of the value of £50 per annum tenable for three years, to the Royal School of Mines, London, and the Royal College of Science, Dublin, are given in competition at the May examinations. Six are awarded each year—three to each institution. The exhibitions entitle the holder to free admissions to all the Lectures, and to the Chemical and Metallurgical Laboratories at those two institutions.

The competition for the Whitworth Scholarships, tenable for three years, is also in part determined by the results of the May examinations.

A grant in aid of a new building, or for the adaptation of an existing building, for a School of Science may be made at a rate not exceeding 2s. 6d. per square foot of internal area, up to a maximum of £500 for any one school, provided that certain conditions are complied with and that the school be built under the Public Libraries and Museums Act, or be built in connection with a School of Art, aided by a Department building grant.

A grant towards the purchase of fittings, apparatus, diagrams, &c., of 50 per cent of the cost of them is made to Science Schools. And where a school is furnished with a laboratory, properly fitted up, payments are made on account of students who during the year receive 25 lessons in laboratory practice.

Special extra grants in the form of capitation payments are made in fully organised Science Schools.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are given at South Kensington:—

Chemistry, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Inorganic Chemistry, commencing October 2, 1878. A Course of Thirty Lectures on Organic Chemistry, commencing January 13, 1879. Fees—Lectures on Inorganic Chemistry, £4; Lectures on Organic Chemistry, £3; together, £6.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Tuesday, October 1, 1878. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month.

Physics, by Professor Frederick Guthrie, F.R.S. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures.* The Course will commence on October 1, 1878. Fee for Lectures and Laboratory work, £16.

Metallurgy, by Dr. Percy, F.R.S. The Course will consist of about Ninety Lectures, commencing on October 21, 1878.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the Student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin,

* A detailed account of the Laboratory Instruction in Physics will be found in the Students' Number of the Chemical News for 1875 (No. 824).

alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the Student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a Student who has not furnished satisfactory proof that he is able to obtain accurate results.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the institution. Those for the ensuing Session include Chemistry, Mining, and Applied Mechanics.

KING'S COLLEGE.

(Department of Engineering and Applied Science.)

Professor of Chemistry.—C. L. Bloxam, F.C.S.

Demonstrator.—W. N. Hartley, F.C.S.

Assistant Demonstrator.—J. M. Thomson, F.C.S.

On Tuesday and Friday at 10.20 a.m. Students of the First Year are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a View of the Forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic elements and their principal Compounds are described.

The Metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts; and the processes of the different Manufactures, of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *vivâ voce* and by written papers, are held at interval during the course at the usual Lecture hour.

Second Year.—Students attend in the Laboratory twice a week, on Tuesday and Thursday, at 10.20, and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this Department may be admitted to this Class at any period of his study on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of extra Fees, at any time except during the vacation, and for a period of one, three, six, or nine months, as may best suit their convenience. The laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory Fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

Special hours and fees are arranged for the convenience of such Third Year Students as wish to study Analytical Chemistry.

Fees.—Chemistry per term, £3 3s. od.; per ann., £8 8s. od.; Practical Chemistry per term, £4 4s. od.; per ann., £8 8s. od.; Experimental and Analytical Chemistry—One Month (daily attendance), £4 4s. od.; Three Months (daily attendance), £10 10s. od.; Six Months (daily attendance), £18 18s. od.; Nine Months (daily attendance), £26 5s. od. A student taking a month's ticket may attend daily during 1 month, or 3 days a week during 2 months, or 2 days a week during 3 months.

Rules as to Admission of Students.

I. The Academical Year consists of Three terms: Michaelmas Term, from beginning of October to the week before Christmas; Lent Term, from the middle of January to the week before Easter; Easter Term, from Easter to the beginning of July.

II. The days fixed for the Admission of New Students in the Academical Year 1878-79, are Tuesday, October 1, Tuesday, January 14, and Wednesday, April 23.

UNIVERSITY COLLEGE.

Faculty of Science.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

I. General Course.

Lectures daily (except Saturday) from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the whole Course of Lectures, £7 7s.; for the First or Second Half Course separately, £4 4s.; for the Second Half, when the first has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise Class, £2 2s.

The instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by an Assistant.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

Organic Chemistry commences in the second week in February, and occupies five Lectures weekly till about the end of March.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the Tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

II.—Analytical and Practical Chemistry.

A. *Birkbeck Laboratory.* (*Men.*)

Chief Assistant.—C. A. Bell, B.A., M.B.

The Laboratory and offices are open daily from 9 a.m. to 4 p.m., from the 3rd of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees, for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials.

Elementary Chemistry.

Chemical Theatre. (*Women*).

Lectures—Wednesday and Friday, from 4 to 5.

A Class of Elementary Chemistry, including the subjects required for Matriculation, will be given during the Winter Session by the Chief Assistant in the Chemical Laboratory.

The instruction will consist partly of Lectures, partly of Laboratory Experiments performed by the Students.

Fees for the Course, including use of apparatus and materials, £4 4s.

B.—Summer Practical Courses.

Chemical Theatre.

1. *Elementary Course.* (*Men.*)—About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May.

Fees—including the cost of materials and apparatus: for the Course, £5 5s.; for a Second Course, £3 3s.

2. *Senior Course.* (*Men.*)—This Course consists of Twenty Lessons of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

Fees—including the costs of materials and apparatus: for the Course, £5 5s.; for a Second Course, £4 4s.

III.—Summer Matriculation Course. (*Men.*)

C. A. Bell, B.A., M.B.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of oral lessons. These lessons will begin on April 16th, 1879, at 11.

The Class will meet on Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12.

Fee, including cost of materials and apparatus, £4 4s.

Chemical Technology.

Professor Charles Graham, D.Sc., M.I.C.

The Course of instruction in this Department is designed to afford to Students who propose to devote themselves to industrial pursuits in which Chemistry plays an important part, or to prepare themselves for the profession of Consulting Chemist, the instruction essential for their success in their future line of work. It will also be found of value in two of the branches (Organic and Inorganic Chemistry) in which the Degree of Doctor of Science can be taken at the University of London, and also an essential training for those Students who propose to qualify themselves for Membership of the Institute of Chemistry of Great Britain and Ireland.

Assuming that the Student enters for a three years' study, the following will give an idea of the nature of the work during the period:—

In the first year the Student will attend Lectures on Theoretical Chemistry, and work at Analytical Chemistry in the Chemical Laboratory, and will also attend Lectures on Mathematics, Mechanics, and Physics. The Mechanical Drawing Class should also be attended during the first year by all Students.

In the second year, the Student will again attend the Lectures on Theoretical Chemistry, and will begin his study of Applied Chemistry by attendance on the Lectures in this subject, and by practical work in the Laboratory on the applications of Chemistry.

The third year will also be chiefly occupied with attendance on the Lectures on Chemical Technology, and in practical work connected therewith in the Laboratory.'

In the second and third years the Student will, in addition to the foregoing subjects, which are common to all, attend Lectures and work at such other branches of Pure and Applied Science as may be deemed advisable after consultation with the Professor.

Students entering the College with more advanced scientific knowledge will be able to shorten the Course described to two years, or even one year, as may be found advisable.

For the convenience of those already engaged in business, &c., it is arranged that they can attend a Course of Lectures upon any one subject of Applied Chemistry without being required to attend any other lectures, either in Applied Chemistry or in other subjects.

Courses of Lectures.

Chemical Theatre. (*Men.*)

During first term—Course A, Monday, from 4 to 5, Chemistry of Brewing; Course B, Thursday, from 4 to 5, beginning October 10th, Chemistry of the Alkali Trade.

During second term—Course C, Tuesday, from 4 to 5, Soap, Glass, Pottery, Cements; Course D, Thursday, from 4 to 5, Agricultural Chemistry.

Fees—for each Course, £2 2s.; for the four Courses together, £5 5s.

In the Session 1879-80, it is proposed to treat of the following subjects:—

(1) Heating and Lighting: Gas, Fuel, Furnaces.
(2) Metallurgical Chemistry.
(3) Dyeing and Calico Printing.
(4) Paints, Oils, Varnishes; or Distilling, Vinegar-making, Bread and Biscuit-making.

Students desirous of working at subjects not included in the foregoing Courses, such as Photography and Photographic materials, Paper-making, Gas-tar products, the products of the Distillation of Wood, Tanning, and other Chemical industries, will receive individual instruction in the Laboratory.

Chemical Laboratory.

The instruction in the Laboratory in Chemical Technology, under the direction of the Professor, will consist of the examination and valuation of raw materials used, and of the final products obtained, in various manufacturing industries, and of experimental examination of the processes employed in the arts and manufactures.

The Laboratory is supplied with apparatus and utensils for such investigations.

Each Student works independently, and the Professor will arrange the course of practical work according to the requirements of the individual Student.

The Laboratories are open daily from 9 a.m. to 4 p.m., from the 2nd of October until the middle of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees—for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials.

Hygienic Laboratory.

Demonstrator.—Mr. Charles E. Cassal.

UNIVERSITY COLLEGE, BRISTOL.

Professor of Chemistry.—E. A. Letts, Ph.D., F.R.S.E.
Assistant Lecturer.—W. W. J. Nicol, M.A.

Inorganic Chemistry.

Monday, Wednesday and Friday, 10 to 11.

This Course will be continued during the First and Second Terms, and will be devoted to a consideration of the Theory of Chemistry, Chemical Physics, and Descriptive Inorganic Chemistry. In treating of the various substances under the latter heading, special attention will be given to their applications in the arts and manufactures. Tutorial Lectures will be given once a week by the Lecturer on those points in the course which require detailed explanation.

Fee for the Course, £4 4s.

For students who have paid Laboratory fees in the Session to the amount of £8 8s., this fee will be reduced to £3 3s.

Chemical Analysis.

A Course of about Twenty Lectures to be delivered during the First and Second Terms.

These lectures are recommended to all studying Practical Chemistry, and are intended to familiarise the student with the chief methods of Qualitative and Quantitative Analysis, and will partly take the form of demonstrations.

Organic Chemistry.

The Course will consist of about Twenty Lectures, and will be delivered in the Third Term of the Session. They will be devoted to the general consideration of the Carbon Compounds. Special attention (as in the Winter Course) will be given to the applications of Organic Chemistry to the Arts and Manufactures, more particularly to Dyeing and the Manufacture of Coal-Tar Products, &c. It is intended that the subject of the Summer Course of Lectures should be in sequence to that of the Winter Course.—Fee, £2 2s. for this course alone; £5 5s. for this and the Winter Course together.

Practical Chemistry.—Laboratory Instruction.

The Laboratory will be open daily from 10 a.m. to 5 p.m., except on Saturdays, when it will close at 1 p.m. Instruction will be given in the Laboratory in all branches of Practical Chemistry, including Qualitative and Quantitative Inorganic and Organic Analysis, the preparation of Chemical Products, and Inorganic and Organic Research. Special facilities will be afforded to those who desire to study Practical Chemistry as applied to the different processes employed in the Arts and Manufactures.

Fees—

	6 Days a Week.	3 Days a Week.	2 Days a Week.
Per Session	18 gns.	10 gns.	7½ gns.
„ Two Terms ..	13 „	7½ „	5½ „
„ One Term ..	7 „	4 „	3 „
„ Month	3 „	2 „	1½ „

In order that Students may have an opportunity of acquiring some knowledge of Applied Chemistry, excursions to some of the Mines and Manufactories of the neighbourhood will be made once a fortnight (on Saturdays) during the Summer Term. They will be conducted by the Professor or by the Lecturer. Past or present Students of the College desirous of taking part in these excursions are invited to apply to the Professor of Chemistry at the commencement of the Summer Term.

Evening Lectures.

Lecturer.—W. W. J. Nicol, M.A.

Tuesday and Thursday, 8 to 9.

This course will consist of Two Lectures a week; they will be devoted to the consideration of the Principles of Chemistry and the Study of the chief Non-Metallic Elements. In treating of the various products under the latter heading special attention will be devoted to their applications in the Arts and Manufactures.

Fee, 8s. per Two Terms.

Practical Class.

Professor.—E. A. Letts, Ph.D.

Lecturer.—W. W. J. Nicol, M.A.

Wednesday and Friday, 7 to 9.

A Practical Class will be formed for instruction in Qualitative and Quantitative Analysis provided a sufficient number of Students enrol. The Fee for the course (extending over the first and second terms) will be £4 4s.

Scholarships.

The following College Scholarships, open to women as well as men, will be competed for in October:—

One Chemical Scholarship of the value of £25, tenable for one year.

Three General Scholarships of the value of £15 each, tenable for one year.

Four Scholarships for Women, offered by the Clifton Association for Promoting the Higher Education of Women, will be competed for at the same time. Of these, two will be entrance Scholarships; that is, they will be open only to those women who have not already commenced systematic study at the College. The other two will be open to all women excepting past and present scholars. Each of the four will be of the value of £15, tenable for one year, at University College, Bristol. Two of them may be augmented up to the maxiumum sum of £50 each, should such aid be necessary.

The Chemical Scholarship will be awarded principally by the marks obtained in Chemistry; but in case the best Candidates in it are nearly equal, account will be taken of their marks in other subjects.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor of Chemistry.—A. H. Church, M.A., Oxon.

Assistant.—Mr. C. Rawson.

The Collegiate year is divided into two Sessions, one beginning in February and ending in June, the other beginning in August, dividing in October, and ending in December.

During each Session the following Courses are given:—

36 Lectures on Inorganic Chemistry.
36 Lectures on Organic Chemistry.
36 Lectures on Agricultural Chemistry.
36 Laboratory Lessons in Chemical Manipulation.
36 Laboratory Lessons in Qualitative Analysis.
36 Laboratory Lessons in Quantitative Analysis.

The College Laboratory is open every day, except Saturday, from 9 a.m. till 5 p.m.

Advanced Students have the privilege of working at all times when the Laboratory is not occupied by other classes.

For the future the Collegiate year will be divided into three terms instead of two.

THE YORKSHIRE COLLEGE, LEEDS.

Professor of Chemistry.—T. E. Thorpe, Ph.D., F.R.S., F.C.S.

Assistants.—Mr. W. H. Wood, Mr. C. H. Bothamley.

Lecture Courses.

1. General Course on Inorganic and Organic Chemistry—Monday, Tuesday, Wednesday, and Thursday, at 4 p.m., from October to the end of March. Fee for the Course, £4 4s.

2. Lectures on Laboratory Practice and Chemical Calculations—Thursday, at 10 a.m., during the First and Second Series. Fee, £1 1s.

3. Lectures on the Chemistry of the Non-Metals—Saturday, at 12 a.m., during the First and Second Terms. Fee, 10s. 6d.

Laboratory Courses.

The College Laboratory will be open daily from 9 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it will close at 1 p.m.

Fees for the Session—Students working six days per week, £17 17s.; four, £13 13s.; three £11 11s.; two, £8 8s.; one, £4 4s.

Class in Practical Chemistry, Saturday mornings, from 9 to 12, during First and Second Series. Fee £1 11s. 6d.

Practical Chemistry for Medical Students.—On Monday and Wednesday, from 9 to 11 a.m., from May to the end of July.

Evening Classes.

A Course of twenty Lectures by Prof. T. E. Thorpe, F.R.S., on the Elements of Inorganic Chemistry (the Non-Metals) will begin during the first and second Terms, on Fridays, at 8 p.m.,, beginning October 12. Fee, 10s. 6d.

Scholarships.

The Cavendish Scholarship. Value £50 per annum, tenable for one year. Awarded for investigations made by the Candidates in any branch of Natural Science taught in the College.

The Salt Scholarship. Value £20 per annum, tenable for two years.

Akroyd Entrance Scholarships. Value £25 per annum,

tenable for three years. Intended for the encouragement of the study of Natural Science. One of these Scholarships will be awarded annually, if in the opinion of the Examiners any Candidate shall possess sufficient merit.

The Clothworkers' Company Scholarships. Four Scholarships, each of the value of £25 per annum, and tenable for one year. Each Scholar will be required to attend regularly the Lectures and Courses of instruction given in the First and Second Years' Course of the Department of Textile Industries at the discretion of the Instructor.

UNIVERSITY OF DURHAM.
COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

Professor of Chemistry.—A. Freire-Marreco, M.A. *Demonstrator*—J. T. Dunn, B.Sc.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m. *Laboratory Fees.*—Students working six days per week, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

Courses of Study.—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may select.

The Session will commence on the October 7, 1878.

Students in Physical Science who have completed their course are admissible by grace of the University to the Academical Rank of Associate in Physical Science of Durham.

No grace for admission to this rank is granted unless the Petitioner has passed two Public Examinations, which are conducted at Newcastle-upon-Tyne.

Associates in Physical Science, who, after their admission to this rank, have been engaged for three years, at least in some practical work of Mechanical, Mining, or Civil Engineering approved by the Council of the College of Physical Science, and have subsequently passed a further Examination having principally reference to the work in which they have been engaged, are admissible, by grace of the University, to the title of Mechanical, Mining, or Civil Engineer of the University of Durham.

Students who have obtained the Academical Rank of Associate in Physical Science, are admissible to the degree of Bachelor of Science, provided not less than two years have intervened from the time of their becoming Associates, after passing an Examination in not less than six of the following subjects, viz.:—(1) Mathematics (pure and applied); (2) Physics; (3) Chemistry; (4) Geology; (5) Engineering; (6) Biology; (7) Either Latin or Greek; (8) Either French or German. The last two of these subjects are compulsory.

A further degree of Master of Science is given by the University. Candidates for this degree must be of not less than two years' standing from the Degree of Bachelor of Science, and will be required to satisfy the Examiners appointed by the Senate of the University, in some branch of one of the Scientific Studies professed in the College of Physical Science.

OWENS COLLEGE, MANCHESTER.

Professor and Director of the Chemical and Metallurgical Laboratories.—H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Professor of Organic Chemistry.—C. Schorlemmer, F.R.S.

Demonstrators and Assistant Lecturers.—Mr. W. C. Williams, F.C.S., Mr. Thomas Carnelley, D.Sc., and Mr. J. B. Hannay, F.C.S.

Hon. Demonstrator in Metallurgical Laboratory.—Mr. James Taylor.

Lecture Courses.

Systematic Chemistry.—Junior Class.—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their Compounds.

Senior Class.—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important Compounds; (2) Organic Chemistry.

The instruction in Systematic Chemistry is given by means (*a*) of Experimental Lectures and (*b*) of Tutorial Classes.

Fee—For each Class, £2 12s. 6d.; for both Classes, £4 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held, which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

Organic Chemistry.—Professor C. Schorlemmer, F.R.S., Monday, Wednesday, and Friday, from 10.30 to 11.30 a.m.

General Course (from October to the end of March).—The subject of this course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general course in Systematic Chemistry.

Extended Course (from the beginning of April to the end of the Session).—This course is suited to the requirements of students preparing for the B.Sc. examination and for those who have previously attended the general course and wish to become more intimately acquainted with the subject. The course will treat of the History of the Old and New Theories, and of the most recent important discoveries in Organic Chemistry, &c.

Fee for the General Course, £2 12s. 6d.; for the Extended Course, £1 11s. 6d.; for both Courses, £3 10s.

Chemical Philosophy.—Prof. C. Schorlemmer, F.R.S., Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Law and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Technological Chemistry.—Monday and Wednesday from 2.30 to 3.30 p.m. The following courses, treating of the chemical principles involved in the most important Chemical Manufactures, will be given during the Michaelmas and Lent Terms:—

1. Twenty Lectures by Dr. Carnelly, on Mondays, from 2.30 to 3.30 p.m., on Water, Air, and the Chemistry of Fuel and the Gas Manufacture.

2. Twenty Lectures by Prof. Schorlemmer, on Wednesdays, from 2.30 to 3.30 p.m., to commence after the Christmas vacation, on the Chemistry of Colouring Matters, Dyeing, and Calico Printing.

Fee for each course, £1 1s.

Physical Chemistry.—Mr. J. B. Hannay, F.C.S. One lecture a week, at an hour to be arranged as soon as a class is formed.

The students will be practically instructed in the use of the apparatus used in Physical Chemistry.

Fee, £1 11s. 6d.

Analytical Chemistry.—Mr. W. C. Williams, F.C.S. Thursday, from 10.30 to 11.30 a.m.

This Course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when they will be closed at 12.30 p.m.

Fees for the Session—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or after Christmas will be charged two-thirds of the fees for the whole Session.

Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

Entrance Exhibitions.

I. Victoria Exhibition (Classics), £15.
II. Wellington Exhibition (Greek Testament), £15.
III. Dalton Mathematical Exhibition, £15.

The Victoria and Dalton Exhibitions are renewable for a second year.

IV. Grammar School Scholarships, £15 per annum, tenable for three years; open to scholars of the Manchester Grammar School only.

V. Two Oxford and Two Cambridge Local Exhibitions, giving free admission to lecture classes in the College for one year, and renewable for two years further are awarded annually on the results of the Oxford and Cambridge Examinations held in Manchester.

VI. Gilchrist Scholarship, £50 per annum, tenable for three years; awarded on the results of the Matriculation Examination of the University of London, in June, 1879.

VII. Rumney Scholarships, £45 per annum, tenable for three years. The next competition will take place in 1880.

VIII. Ramsbottom Scholarship, £40 per annum, tenable for two years. The next competition will take place in 1880.

IX. Crace-Calvert Scholarships, £25 per annum, tenable for two years. The next competition will take place in June, 1880. This scholarship is open only to duly qualified members of the Evening Chemistry Classes.

X. Two Whitworth Exhibitions, giving free admission to certain Day Lecture Classes, which will enable the holders to prepare themselves for the competition for the Scholarships of £100 per annum founded by Sir Joseph Whitworth, Bart., will be offered for competition in June, 1879.

Scholarships.

The following (except the Shakspere Scholarship) are open to the competition of students of the College only. The regulations prescribing the terms of competition and tenure will be found in the "Calendar."

I. Victoria Scholarship (Classics), £40 per annum, tenable for two years.

II. Wellington Scholarship (Greek Testament), £20 per annum, tenable for two years.

III. Shuttleworth (Political Economy), £50, tenable for one year.

IV. Shakspere Scholarship (English Language and Literature), £40 per annum, tenable for two years.

V. Bradford History Scholarship, £45 per annum, tenable for one year, and renewable for a second year.

VI. Dalton Chemical Scholarships, two, each of £50 per annum, tenable for two years.

VII. Dalton Mathematical Scholarships, one Senior and one Junior Scholarship, of the value of £25 each, tenable for one year.

VIII. Platt Scholarships (Physiology), two, each of £50 per annum, tenable for two years.

IX. Heginbottom Physical Scholarship, £20 per annum, tenable for two years.

X. Ashbury Scholarships (Engineering), two, each of £25 per annum, tenable for two years.

Prizes.

I. Lee Greek Testament Prizes, one of £25 and one of £12 10s. value.

II. Classical Prizes, value £5. Junior Classical Prizes, value £5 and £2 10s.

III. Shuttleworth History Prize, value £5.

IV. English Essay and Poem Prizes, each of the value of £5.

V. Early English Text Society's Prizes.—A selection of the Society's publications offered to the competition of students in the Day and in the Evening Classes respectively.

VI. New Shakspere Society's Book Prizes.

VII. Bryce Law Prize, value £10.

VIII. Cobden Club Book Prizes (Political Economy).

IX. Dalton Natural History Prize, value £15.

X. Engineering Essay Prize, value £5.

ROYAL COLLEGE OF SCIENCE FOR IRELAND, STEPHEN'S GREEN, DUBLIN.

Professor of Practical and Theoretical Chemistry.—R. Galloway, F.C.S.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week-day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical Research. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with Free Education, including Laboratory Instruction. tenable for three years; three become vacant each year.

A Diploma of Associate of the College is granted at the end of the three years' course.

ANDERSON'S COLLEGE, GLASGOW.

Professor of Chemistry.—William Dittmar, F.R.S.E.
Chief Assistant.—M. T. Buchanan.
Lecture Assistant.—Robert Lennox.
Junior Assistants.—James M. Bowie and William G. Johnston.

A Course of 100 Experimental Lectures on Chemistry: Daily, Saturdays excepted, from 10 to 11, commencing about the end of October. The Lectures up to the end of the year are devoted to the elements of Chemical Philosophy and to the Chemistry of the Non-metallic Elements. After the new year the Course divides into two branches, viz., the Chemistry of the Metals (on the Mondays and Tuesdays) and Organic Chemistry, select chapters (on the Wednesdays, Thursdays, and Fridays). Six written examinations are held during the Session, which all the members of the class are required to attend.

Fee, £2 2s.

A Course of Tutorial Lessons in connection with the above Lectures will be given by the Class Tutor. Free to the members of the class.

The Laboratory for Practical Instruction in all branches of analysis, including technical assaying, and for original research is open daily (Saturdays excepted) during the Winter Session from 10 to 5, during Summer from 9 to 5. The teaching is conducted on the tutorial system, each student working by himself and on his own subject. The Laboratory is furnished with all the necessaries for chemical investigation.

Fee for the Winter Session, £10 10s.; Summer Session, £6 6s.; two sessions, if paid in advance, £15 15s., or £2 2s. per month.

THE
"YOUNG" CHAIR OF TECHNICAL CHEMISTRY, ANDERSON'S COLLEGE.

Professor.—Edmund J. Mills, D.Sc. (Lond.), F.R.S.
Senior Assistant.—Mr. J. Snodgrass.
Junior Assistant.—Mr. J. Beckit.

This Chair has for its object the instruction of Students in Chemistry as applied to the various branches of industry in Chemical and other works, Metallurgy, Agriculture, &c.

LECTURES.—*Principal Course.*—A Course of Fifty Lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 9 a.m., commencing on November 4th. The Lectures will be illustrated with Experiments, Diagrams, and Models, as well as by the actual Inspection of Manufacturing Processes; and the progress of the Students will be tested by periodical Examinations. The earlier Lectures will have reference to units of weight and measure, to the calculations necessitated by Chemical operations, and to the nature and laws both of the Chemical process and its results. A particular subject will then be considered in comparatively minute detail, embracing for this session Fuel: the concluding lectures will have special reference to aërated waters, and the Bromine and Iodine Industry.

Fee for the Course, Two Guineas. Admission free to Laboratory Students.

Subsidiary Course.—A Course of Thirty Lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 9 a.m., commencing on May 1st. These Lectures are more particularly intended for Dyers, Colour Manufacturers, Brewers and Distillers, Tar Rectifiers, Drysalters, and others interested in a knowledge of Technical *Organic* Chemistry.

Fee for the Course, Two Guineas.

Technical Physical Chemistry.—Mr. J. Snodgrass, Senior Assistant, has arranged to deliver a series of Thirty Lectures and Demonstrations on the Practical Applications of Physical Chemistry.

Fee for the Course, Half-a-Guinea. Laboratory Students, Half-a-crown.

Laboratories.—The Laboratories are open daily from 10 to 4, and on Saturday from 10 to 1 o'clock for practical working by the Students, under the superintendence of the Professor and his Assistants.

The Fee for attending the Laboratories is £18 per Session of Nine Months, £13 for Six Months, £7 for Three Months, or £2 10s. per Month. Students are supplied with a working table containing the ordinary reagents required for analysis, and such apparatus as retort-stands, gas jets, &c. Small articles—such as Berlin porcelain, evaporating basins, funnels, retorts, flasks, beakers, &c.—Students are required to provide for themselves. Larger and more expensive apparatus—such as large evaporating basins, retorts, flasks, bottles, funnels, thermometers, &c.—are lent for experiments. Students must have a fair acquaintance with elementary Chemistry.

The New Laboratory Buildings are in course of erection, and are expected to be ready for occupation during this Session.

Memorandum as to Bursaries.

The Trustees of the "Young" Chair have the superintendence of the Bursaries—regulating the appointment and terms on which they shall be held.

The Nominees of Donors to be appointed if they pass the necessary examinations.

The Bursaries are of the amount of £50 each per annum, tenable for three years, during which the Bursars shall be required to give their whole time and attention to the Lectures and Laboratory duties of the "Young" Chair, paying the ordinary fees. Candidates to have attained sixteen years of age on application, to be of good moral character, and to pass such examinations as may be prescribed by the Trustees in the ordinary branches of an English education and the elementary principles of Chemistry. The Bursaries to be liable to forfeiture on the Bursars failing to exhibit approved progress under the Professor of the Chair, or being guilty of conduct, in the opinion of the Trustees, unworthy of their position. The Bursaries are only given to those whose means are limited, and who intend following some branch of Manufacturing Chemistry.

CHEMICAL LECTURES, CLASSES, AND LABORATORY INSTRUCTION.

CRYSTAL PALACE COMPANY'S SCHOOL OF ART, SCIENCE, AND LITERATURE. SCHOOL OF PRACTICAL ENGINEERING. *Principal*—Mr. J. W. Wilson, Assoc. Inst. C.E.—This school was established with the purpose of affording to Students of Civil or of Mechanical Engineering the advantage of thorough practical instruction in the rudiments of either profession, and in the manipulation of materials. The leading object is to prepare Students, by systematic practical instruction, for professional articles, so that on entering an Engineer's office or works the pupil may at once be useful to his Principal, and enabled to take advantage of the opportunities for learning open to him, because he has mastered the elementary details of the profession. The school is also available for Students already articled, who desire instruction either in the offices or shops. The Colonial Section is designed particularly for gentlemen who are going to the Colonies or abroad, as explorers or settlers. The object proposed is to afford them so much practical knowledge of scientific and mechanical work and expedients as shall enable them best to utilise the means at their disposal, especially when entirely dependent on their own resources.

Special Courses of Lectures are delivered by independent Lecturers not on the Staff of the School, and are an addendum to the curriculum. These Special Courses will include a Course of Six Lectures on the Chemistry of Manufactures and Mines; a Course of Six Lectures on the Mechanics of Practical Mining; and a Course of Six Lectures, by Prof. H. G. Seeley, on the Physiography of the Principal Districts of the World.

In the Ladies Division of the Crystal Palace Company's School of Art, Science, and Literature, a Course of Lectures will be given during the ensuing term on Physical Geography, on Thursdays, at 10.15, a.m., by Mr. G. G. Butler, B.A., F.R.G.S. This subject belongs to Group C of the Cambridge Lectures. New Students can commence the Natural Science Group with this study. Students in Chemical Science of last Session are recommended to take this subject in succession. The treatment of it will aim at being both explanatory and descriptive. Fees: Twelve Lectures and Classes, £1 1s. Twelve Lectures, 10s. 6d. One Lecture, 1s.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES, 44, Berners Street, W.—Prof. E. V. Gardner, F.A.S., M.S.A. The Laboratory is open morning and evening throughout the year.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION, Southampton Buildings, Chancery Lane.—Inorganic Chemistry. Lectures:—Elementary, Tuesdays, 8.30 to 9.30; Advanced, Saturdays, 7 to 8. Practice:—Elementary, Saturdays, 4 to 6; Advanced, Saturdays, 8 to 10. Teacher, Geo. Chaloner, F.C.S. Organic Chemistry:—Course of Thirty Lectures will be given on Tuesday evenings, at 7 o'clock, by Mr. H. Chapman Jones, F.C.S., commencing on October 8th. Practical Organic Chemistry:—This Class will meet in the Laboratory of the Institution, under Mr. Chapman Jones's direction, on Saturdays from 4 to 6 and from 8 to 10 p.m., commencing on October 5th.

NEW CENTRAL SCHOOL OF CHEMISTRY AND PHARMACY, 173, Marylebone Road, London.—Mr. A. P. Luff, F.C.S., and Mr. J. Woodland, M.P.S.

ROYAL VETERINARY COLLEGE, Camden Town.—Professor of Chemistry, Mr. R. V. Tuson.

WORKING MEN'S COLLEGE, 91, Blackfriars' Road.—Teacher of Chemistry, Mr. J. D. Allen.

SCHOOL OF PHARMACY OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 17, Bloomsbury Square.—The school opens on Monday, the 1st of October. Lectures on Chemistry and Pharmacy, by Professor Redwood, on Monday, Tuesday, and Wednesday mornings, at 9 a.m. The Laboratories for Practical Instruction in Chemistry as applied to Pharmacy, &c., under the direction of Prof. Attfield, will be open daily at 10 a.m. throughout the Session. The Professors strongly advise all learners, both before and during attendance at the school, to avoid studying merely by way of "preparation for examination." For "examination" even by the most highly skilled "Board," with ample time at its disposal and a wide area from which to select questions, is admitted by all authorities on education, whether statesmen, teachers, or examiners, to be but a partial test of knowledge and an extremely imperfect test of education. The student who only seeks the kind of information which will enable him to pass an examination mistakes the means for the end. So far from examination being the end, and knowledge the means by which that end is accomplished, knowledge should be the end in view, and examination be regarded as a rough and partial test of the extent to which knowledge has been obtained. Not alone the knowledge which can be tested by examination, but that which cannot be so gauged, should, in all honour and in the highest self-interest, be the knowledge ever assiduously sought. The desire should not be for knowledge which, wanted only for the temporary purpose of examination, is rapidly gained and as rapidly lost, but for knowledge which will last. In short, the one desire should be *education*, that is knowledge accompanied by enlightenment of the understanding, mental training, mental discipline, and general elevation of the intellect. As for "examination," students of the School may rest assured that if they, guided by the Professors, work diligently, thoughtfully, deliberately, and thoroughly, they will with ease and pleasure pass any examination in the subjects in which they have thus been truly educated.

Council Prizes.—At the end of each of the five months' Courses of Lectures on Chemistry and Pharmacy, and Botany and Materia Medica, a Bronze Medal and Certificates of Merit, and at the close of the Session (ten months) a Silver Medal and Certificates of Honour and Merit, are offered for competition by the Council. In the Class of Practical Chemistry, the Silver Medal, two Bronze Medals, and Certificates of Honour and Merit, offered by the Council, are competed for at the end of the Session only.

SOUTH LONDON SCHOOL OF CHEMISTRY, 325, Kennington Road.—Dr. John Muter, F.C.S. Daily, at 10 a.m. Sixty Lectures on Theoretical Chemistry, and Junior and Senior Course of Practical Chemistry.

THE WESTMINSTER COLLEGE OF CHEMISTRY AND PHARMACY, Lambeth Road, S.E.—Messrs. Wills and Wootton. Daily, at 9.30 a.m. Theoretical and Practical Chemistry.

BIRMINGHAM.—MIDLAND INSTITUTE.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.; Friday, at 7; and Saturday, at 3.

BIRMINGHAM.—QUEEN'S COLLEGE.—Mr. A. C. Bruce, M.A.

BRISTOL MEDICAL SCHOOL.—Mr. T. Coomber, F.C.S.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.—J. Campbell Brown, D.Sc. Lond., F.C.S.

SCHOOL OF TECHNICAL CHEMISTRY, 7 and 9, Hackin's Hey, Liverpool.—Mr. A. Norman Tate.

COLLEGE OF CHEMISTRY, LIVERPOOL.—Mr. S. H. Johnson, F.C.S.

LEEDS MECHANICS' INSTITUTION.—Mr. G. Ward, F.C.S.

MANCHESTER GRAMMAR SCHOOL.—Mr. Francis Jones, F.C.S., F.R.S.E.

CHEMICAL LECTURES AT LONDON HOSPITALS.

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	Lecturers on Chemistry.	Days and Hours.	Fees.		Lecturers on Chemistry.	Days and Hours.	Fees.	
			One Course.	Perpetual.			One Course.	Perpetual.
			£ s.	£ s.			£ s.	£ s.
St. Bartholomew's Hosp. and College	Dr. Russell, F.R.S.	M. W. F., 9	5 5	7 7	Dr. Russell	M. Tu. F., 11 [to 1	2 2	3 3
Charing Cross Hospital and College	Mr. Heaton	M. W. F., 11	5 5	7 7	Mr. Heaton	M. F.	2 2	
St. George's Hospital	Mr. Wanklyn	Tu. Th. S., 11½	6 6	8 8	Mr. Wanklyn	Daily, 10	4 4	
Guy's Hospital	Dr. Debus, F.R.S., and Dr. Stevenson	Tu. Th. S., 11	5 5		Dr. Debus	M. W. F., 10 to 1	4 4	
King's College and Hosp.	Mr. Bloxam, F.C.S., Mr. Hartley, and Mr. Thomson	Th. S., 10½	7 7	10 10	Mr. Bloxam and Mr. Hartley, & Mr. Thomson	M. W. F., 10½	5 5	8 8
London Hospital	Dr. Tidy	M. Tu. W. Th., 11	7 7	7 7	Dr. Tidy	M. Th. S., 9	2 2	
St. Mary's Hospital ..	Dr. Wright	M. W. Th., 4	4 4	6 6	Dr. Wright	Tu. F. S.	3 3	
Middlesex Hospital ..	Mr. W. Foster	M. W. Th. F., 9	6 6	8 8	Mr. W. Foster	M. W. F., 3	3 3	
St. Thomas's Hosp. & Schl.	Dr. Bernays	Tu. Th. F., 10			Dr. Bernays	M. Th. F., 10		
University Col. & Hosp.	Dr. Williamson, F.R.S., and Dr. Graham	Daily (ex. S.) 11	7 7	9 9	Dr. Williamson & Dr. Graham	Daily (ex. S.) 11	4 4	7 7
Westminster Hospital ..	Dr. Dupré, F.R.S.	W. Th. F., 3	5 5		Dr. A. Dupré	M. W. F., 10	3 3	

MANCHESTER MECHANICS' INSTITUTION.—Mr. M. A. Watts, M.A.

QUEENWOOD COLLEGE, near Stockbridge, Hants.—Mr. E. W. Prevost, Ph.D., F.C.S., F.R.S.E.

SHEFFIELD BOROUGH ANALYSTS' LABORATORY, 1 and 3, Surrey Street.—Mr. A. H. Allen, F.C.S. Day and Evening Classes.

SHEFFIELD SCHOOL OF MEDICINE.—Mr. A. H. Allen, F.C.S. A course of forty-five Lectures on Inorganic and Organic Chemistry is delivered by Mr. Alfred H. Allen during the Winter session. The Summer Course of Practical Chemistry is under the direction of Mr. A. H. Allen.

UNIVERSITY OF ABERDEEN.—Prof. J. S. Brazier.

ABERDEEN SCHOOL OF SCIENCE AND ART MECHANICS' INSTITUTION.—Mr. Thomas Jamieson, F.C.S.

Dundee Literary Institution Chemical and Physical Laboratory.—Lecturer on Chemistry, Mr. Frank W. Young, F.C.S.

University of Edinburgh.—Prof. A. Crum Brown, F.R.S.E.

School of Medicine, Edinburgh.—Dr. Stevenson Macadam, F.R.S.E., Mr. Falconer King, and Mr. Ivison Macadam.

School of Pharmacy and Chemistry, Edinburgh.—Mr. R. Urquhart, Mr. T. W. Drinkwater, F.C.S., L.R.C.P., and Mr. D. M'Alpine, B.Sc. Day and Evening Classes.

Minto House Medical School, Chambers Street, Edinburgh.—Lectures and Classes.

Glasgow University.—Prof. J. Ferguson.

Glasgow Mechanics' Institution.—Mr. R. R. Tatlock, F.R.S.E., F.C.S.

Glasgow Veterinary College.—Mr. Stephen Cooke, F.C.S.

School of Chemistry, 138, Bath Street, Glasgow.—Dr. Wallace, Mr. Tatlock, and Dr. Clark. Day and Evening Classes.

Chemical Laboratory, 144, West Regent Street, Glasgow.—Dr. Milne. Day and Evening Classes.

Analytical Laboratory, 88, Hope Street, Glasgow.—Dr. A. T. Machattie, F.C.S. Day and Evening Classes.

Queen's College, Belfast.—Dr. Andrews, F.R.S., &c.

Queen's College, Cork.—Dr. Maxwell Simpson.

Queen's College, Galway.—Dr. T. H. Rowney.

Royal College of Surgeons in Ireland.—Dr. C. A. Cameron.

Dublin, Carmichael School.—Dr. C. R. C. Tichborne.

Dublin, Catholic University.—Mr. Campbell.

Dublin, Dr. Steevens's Hospital and Medical College.—Mr. McHugh.

CYANOGEN COMPOUNDS IN ALKALI MAKING.

By JAMES MACTEAR.

An interesting method of *destroying* the cyanogen compounds formed in the black-ash process, patented by M. Pecheney has recently been introduced to the alkali trade by Mr. Weldon. It consists in the addition of a portion of sulphate of soda at the end of the usual reaction; this apparently oxidises the cyanogen compounds, and enables, in consequence, a much whiter quality of soda-ash to be produced.

The necessity for thus destroying the cyanogen compounds *can be altogether avoided by preventing their formation*, which, as shown by actual working, is a comparatively easy matter.

The formation of the cyanogen compounds takes place towards the end of the balling operation, at which point a high temperature of the mass prevails.

By reducing to the lowest possible point, the amount of mixing coal (even to under 29 per cent on the sulphate), and using as prescribed in my patented system of black-ash manufacture, barely one equivalent of carbonate of lime (say 70 per cent), the fusing-point of the charge is so much reduced that the decomposition of the sulphate can be perfectly attained at a temperature much lower than is usually employed. In such a case, however, the black-ash drawn from the furnace would be very "thin," and on cooling extremely dense and difficult to lixiviate, but the addition of caustic lime, either with or without a portion of coal or cinders (as is done in my system), increases as required the porosity of the black-ash, and renders the balls easily soluble, so that by careful attention the formation of cyanogen compounds can be reduced to at most a trace, with perfect decomposition of the sulphate and thorough lixiviation of the black-ash produced.

St. Rollox, Glasgow, Sept. 3, 1878.

THE POLYTECHNIC SCHOOL AT AIX-LA-CHAPELLE.*

This excellent institution is still maintained in a state of admirable efficiency. Of the 257 regular students who attended during the last term, 66 were devoting their attention to architecture, 60 to civil engineering, 61 to mechanical engineering, 36 to chemistry, 31 to metallurgy, and 3 to land-surveying. The number of students attending the lectures on experimental chemistry was 17; analytical chemistry, 18; practical work in the laboratory (analytical department), 34, (technological department), 12; attending lectures on technological chemistry, 28; attending practical lessons in designing, and arranging chemical works, 9.

An account of the station in life occupied by the fathers of the students contains some interesting facts: 107 were Government officials, 67 merchants, 35 manufacturers, and 28 working-men, all other occupations only amounting to 62. Whilst we cannot repress a smile at the number of officials, we recognise the exceeding importance of the fact that 28 working-men were able to procure for their sons a scientific training so practical and so thorough as the Polytechnic School of Aix-la-Chapelle offers. Such institutions, if opened in England and made as accessible, would do more for our national prosperity than any conceivable number of Board-schools. One painful fact, however, strikes us—among the Associations existing among the students, we find mention of what seems to be a Duelling Club!

CORRESPONDENCE.

STATEMENT OF THE RESULTS OF ANALYSIS OF COMMERCIAL PHOSPHATES.

To the Editor of the Chemical News.

Sir,—It is so highly desirable that a uniform system of stating the analysis of phosphatic materials should be adopted that I have thought it well to risk doing what I trust you will excuse me saying is, I think, usually a fruitless task, viz., writing to Editors.

The completion of the labours of the Committee appointed to enquire into the best methods of analysing and reporting commercial phosphates affords an opportunity, which I think should not be lost, for chemists to adopt simultaneously the most approved method of *reporting* at least.

Before remarking on this subject let me allude to a letter in the Chemical News, vol. xxxviii., p. 101, by Mr. Smetham, who does not agree with the recommendation of the Committee to reckon the acetate of ammonium precipitate as ferric and aluminic phosphates, because he has not usually found it to have that composition as actual analysis. I may just say that my experience confirms the findings of the Committee. I have analysed a large number of these residues and invariably find the phosphoric anhydride to be almost identical with the quantity found by reckoning as phosphate of iron.

The plan I adopt is:—Filter off the residue, wash well, ignite, and weigh. If the weight is not more than a half per cent, calculate it as iron phosphate, dissolve it in nitric acid, and add ammonium molybdate; the appearance of the precipitate affords a check, and the error, if any (which is unlikely), cannot exceed one-tenth per cent. If the residue exceeds a half per cent estimate by ammonium molybdate and magnesia as usual. With the small quantity the process is neither prolonged nor costly.

* "Program der Königlichen rheinisch westfälischen Polytechnischen Schule zu Aachen für den Cursus 1878-79. Aachen: J. J. Beaufort.

Now, as to the statement of results. I presume it is not intended to take steps to get chemists to pledge that they will state results in a certain way. It will probably be a partial and gradual change, but the committee need scarcely expect that their recommendation will be adopted unless they propose a plan which commends itself as superior to all other methods by its simplicity, accuracy, sufficiency, and convenience. I do not think, however, that the plan proposed fulfils these conditions, and I beg to submit the following remarks :—

Nothing can suit the analyst better than to state as phosphoric anhydride, soluble or insoluble, and if it be said that the manufacturer and public are not well acquainted with the meaning of this term, much the same may be said of the terms commonly employed. On the other hand, nothing suits the manufacturer better than to state as insoluble phosphate of lime, because he knows the term and because it enables him to make use of the highest possible representation, and this statement would also remove all ambiguity from the consumer, who is often in doubt which phosphate is implied. I have long been in the way of reporting all phosphatic manures thus :—

Sol. phosphoric anhydride —·— = insol. phos. of lime —·—
Insol. ditto ditto —·— ditto ditto —·—

I find this plan convenient and generally acceptable. Iron and alumina phosphate can also be shown, if desired, thus :—

Insoluble phosphoric anhydride —·— { = to insol. phos. of lime —·— and to phos. of iron —·—

When the Committee have finally fixed upon what they consider the best plan, might they not send a circular to all analysts, asking them to agree to analyse if possible, but at any rate, to *report*, in a certain manner?—I am, &c.,

T. Jamieson.

North of Scotland School of Chemistry and Agriculture, 235A, Union Street, Aberdeen, August 29, 1878.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—I have before me Colonel Bolton's Reports to the Secretary to the Local Government Board for May, June, and July last. In them I find that the water of two Companies—the West Middlesex and Grand Junction—has been analysed by two different chemists, Drs. Tidy and Whitmore. The samples in either case were taken from the main. I know from Dr. Tidy's own lips that he does not himself place much trust in his figures, which I intend quoting ; but pray compare the following results :—Reducing Dr. Tidy's figures to parts per million, the two gentlemen found of the so-called organic ammonia :—

	Dr. Whitmore.	Dr. Tidy.	
West Middlesex ..	0·07	0·14	May.
Grand Junction	0·07	0·13	,,
West Middlesex ..	0·06	0·11	June.
Grand Junction	0·07	0·13	,,
West Middlesex ..	0·05	0·14	July.
Grand Junction	0·07	0·14	,,

It is clear that the difference between the results of the two analysts is due to some *constant* error of analysis. Could they not agree on this point, or is the "organic ammonia" method not capable of giving an absolute result, but only a result depending upon the individuality of the analyst? Surely Reports on the same water differing at the ratio of almost 1 to 3 can only cause a confusion in the mind of chemists and the public generally. —I am, &c.,

Gustav Bischof.

Analytical Laboratory, 4, Hart Street, Bloomsbury, London, W.C., August 28, 1878.

NOTES AND QUERIES.

Analysis of Artificial Manures.—Will any of your readers oblige by giving me, through the medium of your columns, the titles of two or three good works on the analysis of artificial manures, as well as on the manufacture of sulphuric acid?—E. D. B.

Just published (London: J. and A. CHURCHILL). price 16s.

A HANDBOOK OF MODERN CHEMISTRY. By Charles Meymott Tidy, M.B., F.C.S., Professor of Chemistry and of Forensic Medicine at the London Hospital.

In 8vo., cloth, price 2s. 6d.,

ANALYTICAL TABLES for Students in PRACTICAL CHEMISTRY. By J. Campbell Brown, D.Sc. (Lond.), F.C.S. Professor of Chemistry and Toxicology at the Liverpool Royal Infirmary School of Medicine, and Lecturer to the Liverpool School of Science.

London: J. and A. CHURCHILL, New Burlington Street.
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ORGANIC MATERIA MEDICA.
By DR. MUTER.

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THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

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ALBERT EMBANKMENT, S.E.

The WINTER SESSION will commence on October 1st, when an Address will be delivered by Mr. Nettleship, at 4 p.m. The fees may be paid in one sum or by instalments. Special entries may be made to any Lectures or to Hospital Practice, and there are special arrangements made for Students entering in their second or in subsequent years; also for Dental Students. Qualified Practitioners are admitted as perpetual Students, on payment of a small fee. There are special classes for the Preliminary Scientific and First M.B. of the University of London, not confined to Students of the Hospital.

PRIZES AND APPOINTMENTS.

Two Entrance Science Scholarships, of £60 and £40 respectively, are awarded in October, after an examination in Botany, Chemistry, Physics, and Zoology, exactly similar to that for Honours in the Preliminary Scientific of the University of London. All First Year's Students who have entered during the Summer or Winter Sessions are eligible to compete.

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The Glasgow Corporation are prepared to receive Tenders for the purchase of the Tar and Ammoniacal Liquor produced at the Dalmarnock Gas-Works from and after 1st September, 1879. The Contract to be for such number of years as may be agreed upon. Forms of Tender, on which offers must be made, may be had, and further particulars obtained, on application to the Manager at the Gas Office, 42, Virginia Street, Glasgow, and offers endorsed "Tender for Residual Products" will be received by the subscriber up till Saturday, the 26th October next. Suitable ground for the erection of Chemical Works may be acquired in the immediate neighbourhood of the Gas-Works.

The Corporation do not bind themselves to accept the highest or any Tender.

J. D. MARWICK, Town Clerk.

City Chambers, Glasgow,
September 3, 1878.

SALE OF GAS TAR AND AMMONIACAL LIQUOR AT THE ROYAL ARSENAL, WOOLWICH.

The Secretary of State for War is prepared to receive Tenders for the Purchase of such quantities of Gas Tar and Ammoniacal Liquor as may be for disposal during the period of three years from the 1st October, 1878, at the Royal Arsenal, Woolwich, where Forms of Tender and all information may be obtained, on application to the Commissary General.

The Tenders are to be delivered at the War Office, 5, New Street, Spring Gardens, S.W., by 12 o'clock noon, on Wednesday, the 11th day of September, 1878, addressed to the Director of Army Contracts, and marked on the outside, "Tender for the Purchase of GAS TAR, &c."

EVAN COLVILLE NEPEAN,
Director of Army Contracts.

Army Contract Department, War Office,
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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 981.

ON THE

ACTION OF HEAT UPON THE SELENATE OF AMMONIUM.*

By CHARLES A. CAMERON, M.D., and EDMUND W. DAVY, M.D.,
The Professors of Chemistry and of Forensic Medicine, Royal College of Surgeons, Ireland.

THE study of the action of heat on the sulphate of ammonium under different circumstances, having, in the hands of Gladstone, Schweitzer, and other chemists, led to interesting results, we thought it desirable to institute some experiments on the selenate of that base, to ascertain whether any analogous products would be obtained on its exposure to that agency, selenic and sulphuric acids agreeing, as is well known, so closely in their properties, and this subject being, as far as we were aware, hitherto uninvestigated.

The salt which was employed in our experiments was obtained by saturating dilute selenic acid with carbonate of ammonium, and evaporating the product to dryness in a water-bath; and in its preparation it was found that though an excess of the carbonate, or even of caustic ammonia, had been added to ensure the neutrality of the resulting salt, still on evaporation to dryness it had always a more or less acid reaction; and this was observed to be the case, though it was again and again dissolved and rendered strongly alkaline by the addition of more of the carbonate or of caustic ammonia; thus showing that a temperature of 100° C., or even somewhat below it, was sufficient to decompose a portion at least of the neutral salt, and form more or less of an acid selenate of ammonium.

This observation is analogous to the results of Dr. Gladstone, who several years ago pointed out that when solutions of the sulphate, oxalate, phosphate, and citrate of ammonium (compounds of bi- and tribasic acid with that base) were boiled, they were partially resolved into free ammonia and acid salts.

It was further noticed in our experiments on the selenate that the application of heat was not necessary to produce this effect, for by simple exposure to the air a small quantity of an acid salt was produced (as was shown by blue litmus-paper moistened with the salt), which had even been made strongly alkaline by excess of ammonia, soon becoming red on exposure to the air. On making comparative experiments with the solutions of several other ammoniacal salts—some of which were even rendered alkaline by caustic ammonia—it was found that they all in like manner reddened blue litmus-paper under the same circumstances, indicating, apparently, the formation in some way of a small quantity of an acid or acid salt: but this curious observation, which we are not aware has hitherto been made, is a matter for our further investigation.

But to return to the selenate of ammonium. Thinking that it might be possible by the action of a higher temperature than that of 100° C., obtainable in the water-bath, to convert the whole of the neutral selenate into an acid salt (no such combination having hitherto been described), the thoroughly dried salt was heated in a bath of paraffin, the temperature to which it was exposed being indicated by a thermometer.

Under this treatment it was found that when the temperature rose to about 180° C., the evolution of a minute quantity of ammonia could be detected by moistened turmeric or by reddened litmus-paper; and finding that the ammonia disengaged increased with the rise of temperature, the heat was gradually raised to 250° C., when its development became much more abundant, whilst at the same time water and selenium began to be separated.

This temperature was then continued as long as ammonia was evolved and till acid vapours made their appearance, when the heat was withdrawn. On examining the residue after this treatment we found that the selenate of ammonium had been completely decomposed, there being only selenium and selenious anhydride left. It should also be stated that the selenate of ammonium, before this final breaking-up, was found to possess a strong acid reaction, indicating the formation of an acid salt in the first stage of its decomposition by heat.

Having thus ascertained that when this selenate was strongly heated it yielded the following products, viz.—ammonia, water, selenium, and selenious anhydride—and wishing to determine whether these substances were the only products, we heated some of the selenate of ammonium in a tube filled with mercury, when a considerable volume of gas not absorbed by water was obtained, which was found to be nitrogen.

From the results of these and other experiments we have made, we have come to the conclusion that when selenate of ammonium is exposed to heat it first resolves itself into an acid selenate with the evolution of ammonia; and that this salt, on further heating, breaks up into selenium, selenious anhydride, water, and nitrogen, and that the reactions which occur in the process may probably be expressed by the following formulæ:—

1st stage.—$4[(NH_4)_2SeO_4] = 4(NH_4.H.SeO_4) + 4NH_3$.

2nd stage.—$4(NH_4.H.SeO_4) = Se + 3SeO_2 + 10(H_2O) + N_4$.

But as yet different circumstances have prevented our being able to confirm their correctness by actual results. The foregoing observations are interesting, as they show that in the first stage of the decomposition of the selenate of ammonium by heat there is an acid salt formed, like as in the case of the sulphate of that base when similarly treated, as was pointed out not long ago by Dr. Schweitzer; but in the separation of selenium in the second stage of the process there is no analogy in the case of the sulphate of ammonium.

* Read before the Chemical Section of the British Association, Dublin, 1878.

ELEMENTARY ORGANIC ANALYSIS BY A MOIST PROCESS.*

By J. A. WANKLYN and W. J. COOPER.

UNDER this title we describe the further development of the researches which were published from the Laboratory of the London Institution some ten years ago ("Historical Sketch of the Limited Oxidation").

We have continued these investigations by taking up the study of the oxidation of organic substances in alkaline solution by means of permanganate of potash, and have obtained the following results:—

Cane Sugar.—An aqueous solution of cane sugar is rapidly oxidised by excess of permanganate of potash in presence of some three times its weight of potash, and, if the materials be evaporated to dryness in the water-bath, is totally oxidised according to the following equation:—

$$C_{12}H_{22}O_{11} + O_{20} = 11H_2O + 4CO_2 + 4C_2O_3.$$

We took—

Cane sugar	1·0 grm.
Solid potash	3·9 grms.
Permanganate of potash	7·0 "

* Paper read before the Chemical Section of the British Association, Dublin, August, 1878.

and about 150 c.c. of distilled water, and heated the materials in the water-bath, continuing the evaporation almost to dryness. We then added a considerable quantity of distilled water, titrated the excess of permanganate, filtered from the brown hydrated binoxide of manganese, which is formed during the reaction, and submitted the entire filtrate to precipitation with chloride of calcium and excess of acetic acid. We washed, dried, and ignited the resulting oxalate of lime, and weighed the carbonate of lime thereby produced, which equalled 1·204 grms.

The oxygen consumed was found by titration to be 0·9351 grm. We have, therefore, experimentally,

Carbon as oxalate	0·289 grm.
Oxygen consumed	0·9351 ,,

And the theory requires—

Carbon as oxalate	0·281 ,,
Oxygen consumed	0·9356 ,,

which accords sufficiently well.

We have directed an evaporation of the material down to dryness in order that the experiment may be sure to succeed. If this point be neglected only about $\frac{1}{10}$ of the theoretical quantity of oxygen may be consumed, and $\frac{9}{10}$ of the correct quantity of oxalate be produced, as was illustrated in our earlier experiments, which we need not publish.

Grape Sugar.—Our experiments on grape sugar were made before we had discovered the secret how to get the oxidation complete.

We obtained from 100 parts of grape sugar 20·7 parts of carbon as oxalate.

The theory $C_6H_{12}O_6 + O_{10} = 6H_2O + 2CO_2 + 2C_2O_3$ requires carbon as oxalate 26·6. This experiment requires repetition with proper regard to the conditions.

Glycerine.—The experiment with this substance was likewise made before we had adopted the precaution of evaporating to dryness in the water-bath.

From 2·78 grms. of glycerine we obtained 0·535 grm. of carbon as oxalate.

Train oil, which we may take to be mainly oleate of glycerine,

$$\left.\begin{matrix}(C_{18}H_{33}O)_3\\ C_3H_5\end{matrix}\right\} O_3,$$

behaves in a most interesting manner when subjected to the action of strongly alkaline permanganate.

We quote from our note-book:—

Train oil	3·184 grms.
Solid potash	14·5 ,,
Permanganate of potash.. ..	50·0 ,,
Distilled water, 500 c.c.	

These materials having been put together there was little action below 100° C., but on evaporation in the water-bath the action became very rapid at approaching dryness, and the permanganate was almost completely used up.

A large quantity of oxalic acid was produced and converted into oxalate of lime, which was burnt into carbonate of lime, yielding 5·248 grms. of carbonate of lime. It was from this and another experiment on almond oil that we learnt the importance of the evaporation to dryness. Both experiments are incomplete, but they show that such complex and stable substances as the animal and vegetable fats are amenable to this method of treatment.

Benzoic Acid was powerfully attacked on being taken to dryness in the water-bath with alkaline permanganate. It appeared to give a very little oxalate.

Lactic Acid was attacked even in the cold.

Acetic Acid resists most strongly, and apparently absolutely.

Alcohol behaves in a most interesting manner. In the cold there is conversion into acetic acid, without intermediate production of aldehyd; and the acetic acid so produced is not subsequently oxidised on heating with excess of potash and permanganate.

The acetic acid was identified by being made into a baryta salt which yielded 53·75 per cent of barium. (Theory, 53·73.)

No oxalic acid was produced.

Amylic Alcohol is oxidised thus:—

$$C_5H_{12}O + O_7 = 2H_2O \times 2C_2H_4O_2 + CO_2$$

and, no doubt, the different varieties of amylic alcohol give different products.

ON A DIRECT METHOD FOR DETERMINING THE CALORIFIC POWER OF ALIMENTARY SUBSTANCES.*

By J. A. WANKLYN and W. J. COOPER.

THE amount of oxygen consumed by an organic substance being the measure of its heat-producing force, the importance to physiologists of a direct and rapid method for measuring the consumption of oxygen in organic fluids is obvious. It is well known that an elementary combustion will effect this object, but, as is likewise well known, the great difficulties which beset it render it unavailable for physiological researches. The process by which we obtain all the results of an elementary combustion can be completed in about an hour, and in the course of our experiments on various organic substances we have been enabled to get an amount of oxygen absorbed which is equal to the theoretical quantity required by the substance operated upon. In point of fact, we have so modified Forchhammer's process as to make it work in a satisfactory manner.

Forchhammer's process, as hitherto practised, does not effect anything approximating to complete oxidation down to carbonic acid and water, as was illustrated by some experiments published by Frankland and Armstrong in 1868 (*vide Chem. Soc. Journ.*, vol. vi., p. 82), which we quote:—

Name of substance (30 parts dissolved in 1,000,000 parts of water).	Oxygen absorbed during six hours.	Oxygen required for complete oxidation.
Gum arabic	0·35	35·5
Cane-sugar	0·15	33·7
Starch	0·30	33·5

Showing that, as usually carried out, the oxidising process does not avail to accomplish more than about one hundredth part of the task set before it.

The modifications whereby we have completely altered the character of the Forchammer process are as follows:—

Instead of simply mixing the standard solution of permanganate with the water to be examined we *distil* a given volume of the water (say, 1 litre) with a considerable excess of standard solution of permanganate, and thereby get more oxidising action than in the ordinary operation. We find advantage in having the liquid strongly alkaline during the distillation; but we render acid before titrating the residue.

The following are the working details:—

A standard solution of permanganate of potash (strength 0·4 milligramme of active oxygen per 1 c.c.) is prepared.

A standard *reducing-solution*, containing protosulphate of iron, and of such a strength that each c.c. exactly corresponds to the permanganate solution, is also prepared.

Solution of caustic potash, 5 per cent, is prepared.

* Paper read before Section D. (Department of Anatomy and Physiology) of the British Association, Dublin, August, 1878.

Diluted sulphuric acid (1 volume of oil of vitriol with 9 volumes of water) is prepared.

These solutions having been got into order the operator may begin.

A litre of the water to be examined is placed in a retort which is conveniently mounted, just as in the ordinary course of water analysis by the ammonia process. Into the retort the operator drops with a graduated pipette 5 c.c. of the solution of potash (to render the water alkaline), and then 5 c.c. of very carefully measured standard solution of permanganate; and then the contents of the retort are boiled by means of a large Bunsen burner, and the water is rapidly distilled off. After the distillation has advanced it will very often happen that the permanganate will show signs of having been used up: if that happens a second, and, if necessary, a third 5 c.c. of standard permanganate must be dropped into the retort, and the distillation continued until 800 or 900 c.c. have distilled over, and only some 200 or 100 c.c. of liquid remain behind in the retort. When the distillation is stopped, the observation that the contents of the retort still contain unacted-upon permanganate must held good; otherwise too little permanganate would have been employed in the operation.

The manner of finishing the operation is of a very obvious description. The operator acidifies the residue in the retort (*i.e.*, he adds 10 c.c. of the diluted sulphuric acid); then he adds a measured quantity of iron-solution, taking care to use a considerable excess; and finally he titrates back with the standard permanganate, and thus becomes provided with numerical data expressing how much oxygen has been used by the litre of water.

Experiments on dilute solutions of cane-sugar have given results approximating very well to theory. Cane-sugar, indeed, we have subjected to a course of oxidations ranging over a very varied scale—from 5 milligrms. to upwards of 10 grms. at a single operation. The reaction is precise, viz :—

(1) $C_{12}H_{22}O_{11}+O_{20}=11(H_2O)+4(CO_2)+4(C_2O_3)$;
(2) $C_{12}H_{22}O_{11}+O_{24}=11(H_2O)+12(CO_2)$.

Equation (1) is valid if the action be restricted to the alkaline solution; and equation (2) is valid when the oxidation has been carried forward so as to be finished in the acid liquid.

ON SOME SUBSTANCES OBTAINED FROM THE ROOT OF THE STRAWBERRY.*

By Dr. T. L. PHIPSON, F.C.S., &c.

I HAVE found in the root of the strawberry (*Fragaria vesca*) certain substances closely allied to some which are contained in the Cinchona barks. I am still occupied with this investigation, which was only begun quite recently, but in the meantime, desire to make known the curious substance I have termed Fragarine, which can be obtained in considerable quantities by the process described below :—

There exists in the root of the strawberry a kind of tannin of a very pale yellow colour, which is soluble in water and in alcohol, and strikes a green colour with salts of iron. It is soluble in water slightly acidulated with hydrochloric acid. With more hydrochloric acid it combines to form an insoluble compound, and is also precipitated in purple flocks by alkalies. It can be obtained pure by evaporating its aqueous solution in an atmosphere of carbonic acid, and is then in the form of a pale yellow amorphous substance, with an astringent taste, devoid of bitterness; it takes a fine purple colour in contact with potash, and colours per-salts of iron dark green. This substance, which may for the present be termed Fragarianine, is a kind of tannin, closely allied to quinotannic acid, but instead of yielding *Cinchona red* like the latter, it yields a somewhat similar substance, which I call Fragarine.

To obtain the latter about 50 grms. of the strawberry root in thin slices are left for forty-eight hours in a stoppered bottle with water acidulated with about 5 per cent of hydrochloric acid. The solution filtered off is of a pale golden-yellow colour; it is strongly acidified by addition of more hydrochloric acid and boiled for an hour or two. As the temperature rises towards boiling point the pale yellow liquid becomes darker and redder, and finally takes a splendid orange-red colour. On boiling it becomes cloudy, and after some time Fragarine is abundantly precipitated in flocks of a reddish brown colour. After allowing the liquid to become quite cold it is filtered, and the new substance collected is washed with cold water. The filtered liquid contains glucose.

Fragarine thus obtained has the following properties:—It is an amorphous reddish brown powder, highly electrical by friction, soluble to some extent in water, alcohol, and ether, dissolving in potash with a fine reddish purple colour. It dissolves in concentrated sulphuric acid, and forms a conjugated acid, the solution of which is brownish purple. Boiling hydrochloric acid does not affect it. Treated with nitric acid it forms a brilliant yellow nitro compound, different from picric acid, yielding no picramic acid when reduced by sulphide of ammonium. Chlorate of potash and hydrochloric acid mixture yields a bright yellow chlorine compound, insoluble in water, decomposed by ammonia.

Heated in a tube Fragarine yields water, is decomposed without fusion, depositing much carbon, and producing a white volatile substance, which condenses in the tube and is soluble in water; the solution produces a green colour with salts of iron; it is probably pyrocatechin. Melting hydrate of potash decomposes Fragarine with production of dark brown substances and a little protocatechuic acid, which can be isolated by ether from the acidulated solution of the products of this reaction, and also colours iron salts green.

Whilst Fragarine is being produced by boiling with hydrochloric acid as above there is diffused through the laboratory a very agreeable odour of essence of cedar. When the same experiment is made with an acid decoction of red and yellow cinchona barks (obtained in the cold) there is produced an odour of heated spermaceti. It is curious that both essence of cedar and cetene of spermaceti contain 32 equivalents of carbon. Instead of giving a dirty green colour with potash, as *Cinchona red* does, Fragarine dissolves with a reddish or brownish purple colour. This is the best way of distinguishing between these two substances. I cannot yet say anything with certainty about its composition ($C_{26}H_{20}O_8$?).

Besides these two substances the strawberry root yields a compound very similar to quinovine; at least, a body similar in many respects to quinovic acid can be obtained by the usual method, but probably not identical with it. There is also a small amount of gallo-tannic acid, but no alkaloid. The tannin mentioned above as Fragarianine appears to be partly combined with ammonia, which causes it to produce the rose or flesh-coloured tint visible in the section of the older roots.

* Read before the Chemical Section of the British Association, Dublin, August, 1878.

Researches on Glycolide.—T. H. Norton and J. Tcherniak.—Pure glycolide is a perfectly white powder, insipid to the taste and without sensible action on blue litmus. It melts at 220°. Ethyl-amin transforms it easily, even at 0° into glycol-ethyl-amin, identical with the compound obtained by Heintz, on acting upon glycolic ether with ethyl-amin. Anilin gives rise to a new body glycol-phenyl-amin.—*Bull. de la Soc. Chim. de Paris.*

NOTES FROM THE PARIS EXHIBITION.

The Captive Balloon.

In the middle of the "Place de Carrousal," behind the Tuilleries, may be seen an enormous globe, which, from a distance, resembles an immense metallic ball: this is the captive balloon, constructed by M. Giffard. Every afternoon it is ascending and descending, each journey taking up about 30 people.

The balloon takes on an average 15 minutes to go up to a height of about 550 metres and come down again; when down, it is held by eight strong cables, each cable under the management of two men, who have to attach and detach it. When anchored in this manner the balloon could bear a wind pressure of 400 lbs. on the square metre without being blown away. It is sufficiently powerful to take up 100 people, but 50 is the maximum which the car will comfortably contain. The diameter of the balloon is 135 feet; therefore it is a little more than 405 feet in circumference. The envelope is formed of seven layers of different materials, all fastened firmly together in such a manner that there is no fear of a rupture. The first layer inside is strong muslin, then a layer of india-rubber, then very strong linen, after which comes a second layer of india-rubber, then another layer of linen, followed by a layer of vulcanised india-rubber, and outside a layer of muslin, over which the varnish is laid, to prevent any escape of gas; and lastly the whole is painted all over with a white zinc paint, which gives it its fine metallic appearance.

The bands of stuff are sewn together in a zigzag manner, to stop the possibility of the seams ripping, and each seam is covered with india-rubber. If all the bands used were laid one after another in a straight line they would extend to a distance of 150 miles.

The envelope, which is of a perfectly spherical form, is enclosed in a net-work of 60,000 meshes; the ropes are not knotted together, as the knots might wear holes in the case, but they are passed through each other.

The cordage altogether weighs 16,000 lbs., not including the cable by which the balloon is held down. This cable is a little more than 600 metres long, and is made somewhat thinner at the lower end than at the upper, so that in case it were to break, the fracture would be at the lower end, and the descent of the balloon would be made much easier, because of the immense guide-rope the aëronauts would have in their aid. The diameter of the cable at the upper end is 8½ centimetres, and at the lower end 6½ centimetres.

The cable passing from the balloon to the bottom of the basin, which has been dug to facilitate the entry into the car, turns round a large pulley and goes along a tunnel 60 metres long to the machine which draws the balloon down.

The large drum on which the cable is wound is 14 metres long, and about 1⅞ metres in diameter; it makes about 30 turns a minute, but in case of necessity it can revolve much quicker. A groove is cut round and round the whole length for the cable to fit in; the drum is worked by two double-cylinder horizontal engines, one at each end, and the steam is generated in two boilers, but one alone is sufficient for the work in the case of either of them getting out of repair.

The direction of the balloon is under the control of one man, who, by simply turning a tap can make it ascend or descend at will. The first few ascensions were directed by M. Giffard himself, but subsequently the direction has been given into the charge of M. Carot.

The car weighs about 3600 lbs., and is made to carry 50 persons comfortably at a time. It is constructed with a round hole in the middle, through which passes the cable, fastened to the cordage above. In case anybody was taken with a desire to commit suicide, he could not carry out his intention, owing to there being a net all round the car. The car is furnished with all kinds of instruments required for making scientific observations or to gratify the curiosity of passengers who wish to know to what height they have ascended; and, further, the car is supplied with ballast and the other necessary appliances for the manœuvring of the balloon in case it was to escape. There are two aëronauts who always ascend to look after the safety of the passengers in case of an accident.

From the height to which the balloon ascends one has a splendid view of Paris and the environs, which should tempt many people to make a journey upwards.

The first idea of making the balloon was brought forward about four years ago by the "International Meteorological Association," which includes most civilised Governments, when it was proposed that a balloon should be constructed for the purpose of studying the conditions of heat and moisture in the atmosphere from the height of one metre to 600 metres, but no Government wishing to undertake the expense of constructing the balloon, this has been done by M. Giffard, who is well known as an engineer. The French Government has contributed nothing to the enterprise, but even charges £4000 for the use of the court behind the ruins of the Tuilleries. The whole of the plans have been designed by the constructor, M. Giffard, from that of the immense machine to wind the cable, to the size and shape of each mesh in the net, and he may feel justly proud at having achieved so great a success.

H. C.

ON SOME PRESUMABLY NEW EARTHS.

By Dr. B. W. GERLAND.

My friend, Mr. Ion. Down, formerly manager of the Alderley Edge Mining Company, and since of the Tharsis Company, called my attention some fifteen years ago to a mineral he had discovered in a vein of the Keuper sandstone. It covers the sides of crevices and cavities with small, shining, dark olive-green crystals, or impregnates the sandstone with pale apple-green colour, and consists principally of vanadate of copper and lead. As this deposit promised to offer vanadium compounds in workable quantity, the only one hitherto found, I took great interest in it, and examined the mineral carefully. Its composition is very complicated: I found nearly one-half of the known elements represented, and separated a group of oxides belonging to the rare earths, possessing properties which distinguish them from those already known. Their behaviour and characteristic reactions, as far as ascertained with the small quantity at my disposal, are as follows:—

The solution of the salts is precipitated by caustic soda and by ammonia: excess of the reagent does not re-dissolve the hydroxides, even in presence of ammonium salts. Sodium, potassium, and ammonium carbonates also cause a precipitate, which is easily dissolved by an excess. This solution is partially precipitated by carbonic acid. The separated substance consists of earth and alkali, fluxes at red heat, and does not give the reactions of alumina. The compound is re-dissolved by boiling with the mother-liquor. The earths are therefore more soluble in neutral alkaline carbonates than in acid carbonates.

Neither barium nor calcium carbonate act on solutions of the pure salts, but if these contain alumina or ferric oxide, the earths are completely separated from the solutions with these oxides.

The oxalates are insoluble in water, acetic acid, and dilute mineral acid, but soluble in strong acids and in sodium carbonate. They are crystalline, of white, or pink, or pinkish blue colour.

The earths form compounds with potassium sulphate, which are sparingly soluble in a concentrated solution of that salt. The more soluble part gives faintly coloured

salts and oxide, and shows the absorption-spectrum of didymium much brighter than the less soluble part, but neither gives the spectrum of erbium. These observations have been kindly verified by Professor Bunsen and Dr. M. H. Watts in June, 1876.

The oxides obtained from the less soluble part of the salts are leather-brown, and those of the more soluble part pale brown. They have no alkaline reaction, and dissolve readily in acids with evolution of heat, even after exposure to an intense heat. All attempts to produce a peroxide failed. The hydroxides and oxides dissolve slowly in ammonium chloride or nitrate solution, hot or cold, provided the ammonia can escape.

The salts formed with hydrochloric, chloric, perchloric, hydroiodic, periodic, and hydrofluoric acid are very soluble in water and alcohol, deliquescent, and not easily obtained in crystals. The chloride solution, evaporated with hydrofluoric-silicic acid, gives on the addition of alcohol only a very slight precipitate.

The sulphates are not very soluble; they crystallise with water in beautiful, hard, large, transparent crystals. The first crystallisation is bluish pink; the last, pale pink. They lose their water above 150°, and then become opaque, with lustre like mother-of-pearl. The analyses of the first and last crystallisation gave the following results:—

	I.	II.
K_2O	21·30	17·54
SO_3	37·10	33·55
Oxide	41·60	47·92
	100·00	99·01

If barium chloride is added to the solution of the salt containing even much free acid, a large portion of the earth separates with the barium sulphate.

The amount of these earths in the mineral is very small, and their extraction is made difficult by the quantity of foreign matter present, particularly alumina and oxide of iron. I have worked up different parcels of picked pieces, amounting to about three tons, and only collected a little above 1 grm. This is partly owing to my trusting too much to the insolubility of the oxalates, whilst, as I have ascertained since, they are perceptibly dissolved by solutions of aluminium and ferric oxalates. Before continuing the examination of these earths I wish to increase my stock, and this I am now enabled to do with greater facilities than before, since the eminent firm who have worked the deposit for some time have most kindly placed the material and the conveniences of their works at my disposal. But the progress of my investigation must necessarily be slow, owing to want of time, and this circumstance, together with the memorandum in a recent number of the Chemical News, on Mosandrium, by Dr. J. Lawrence Smith, induce me to publish my experiences in this imperfect state.

Macclesfield, August 3, 1878.

CORRESPONDENCE.

CYANOGEN COMPOUNDS IN ALKALI MAKING.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxxviii., p. 130, Mr. Mactear remarks:—"The formation of the cyanogen compounds takes place towards the end of the balling operation, when a high temperature of the mass prevails." In this and another passage of the same communication, taken together, Mr. Mactear implies that, in his opinion, cyanogen compounds are formed in the black-ash furnace more readily and in greater proportion at high temperatures than at lower ones. To that opinion I beg to oppose the following facts:

1. In many works it often happens that the same revolver is sometimes worked with a "mixing," the carbonate of lime in which is all in the state of "lime-sludge," and at other times with a mixing, the carbonate of lime in which is all dry limestone. When working with a lime-sludge mixing the average temperature of the furnace is *lower*, owing to the 50 per cent of water which has to be evaporated from the "sludge," than when working with a limestone mixing: and the quantity of cyanogen compounds in the black-ash from the sludge mixing is always *greater* than the quantity of cyanogen compounds in the black-ash from the limestone mixing.

2. A certain revolver was at one time heated by gas. The black-ash made in it contained five times the ordinary proportion of cyanogen compounds. The mode of heating it was changed to the ordinary method of firing with coal, and the proportion of cyanogen compounds in the black-ash at once fell to the ordinary proportion. Nothing was changed except the method of heating; but it was observed that the temperature of the furnace, when fired with coal, was much *higher* than when the heating was done by gas.

3. Hand-furnace black-ash usually contains a smaller proportion of cyanogen compounds than revolver black-ash; and hand-furnaces are usually worked at a higher temperature than is obtained as a rule in revolvers.

4. French hand-furnace black-ash contains a smaller proportion of cyanogen compounds than English hand-furnace black-ash; and in France black-ash hand-furnaces are worked hotter than they are in England, and the charges remain in them a very much longer time.

5. Since I began to introduce the Pechiney process in England, more attention has been given by English alkali makers to the question of the cyanogen compounds in black-ash than they had previously given to it since the commencement of their industry. Nearly everybody have begun experimenting and observing, in the hope of arriving at something which will enable them to avoid having to pay the modest royalty on the Pechiney process. A part of my commission from M. Pechiney has been to insist upon the importance, in order to the production of the best possible black-ash, of the use of a minimum of mixing coal and a high furnace temperature. In several works, in each of which are several revolvers working at different temperatures, my insistance on the importance of these two conditions has led to very careful observation, not only of the effect of different proportions of mixing-coal, but also of the effect, with all manner of mixings, of different furnace-temperatures; and, whatever the mixing employed, it has invariably been found that black-ash made in revolvers working at high temperatures has contained smaller proportions of cyanogen compounds than black-ash made from precisely the same mixings, but in revolvers working at lower temperatures.

6. Those English manufacturers who are employing the Pechiney process are at present acting also upon a suggestion of mine. Together with Pechiney's "additional sulphate" they drop into the furnace a certain quantity of limestone dust, with the object of freeing the nearly finished black-ash from sulphide of sodium as well as from cyanogen compounds. The addition of these bodies of course *cools* the furnace, and it is found that, whereas when the quantity of limestone-dust added with Pechiney's sulphate does not exceed a certain amount the black-ash obtained is nearly free from sulphide of sodium and quite free from cyanogen compounds, the black-ash is *not* free from cyanogen compounds when the proportion of limestone-dust used is sufficient to carry the cooling effect of the after-charge beyond a certain degree.

These facts seem to me to indicate that, to the formation of cyanogen compounds in the black-ash furnace, *low* temperatures are more favourable than high ones. How, then, is it that cyanogen compounds are not found in the charge in the black-ash furnace until "towards the end of the operation," when "a high temperature of the mass prevails"? This is obviously because the quantity of undecomposed sulphate present is then lowest, not because

the temperature is then highest. That sulphate of soda, added to a nearly-finished charge of black-ash containing cyanides and intimately mixed therewith, completely destroys those cyanides, is now demonstrated as completely as any fact of industrial chemistry. This being so it is plain that there can be no cyanides in a black-ash furnace until "towards the end of the operation." Either they cannot form while there is yet much undecomposed sulphate present, or, if they do form, the undecomposed sulphate instantly destroys them.

While, then, Mr. Mactear's idea that a low temperature in the black-ash furnace will help to enable him to "prevent the formation" of cyanogen compounds is contrary to all I have yet learnt on this subject, I am confident that "reducing to the lowest possible point the amount of mixing-coal" is what all alkali-makers must inevitably come to. But so far as the English alkali-makers are concerned, it is to M. Pechiney, my great master and teacher in this matter of soda-making, that they will be indebted for the great advantages resulting from the reduction of their mixing-coal to a minimum. For months past, at his instance, I have been urging this point upon them. I urged it upon Mr. Mactear—who was then using immensely more than "under 29 per cent," although, he told me, he had once been "down to 32"—when I called upon him at St. Rollox, to introduce the Pechiney process to him, on the 23rd July. For months past I have been circulating among the English manufacturers copies of a letter addressed to me by M. Pechiney on the 14th March, in which he says:—"Pour avoir une belle qualité de sel de soude, il faut décomposer le sulfate avec *la moindre quantité possible de charbon*. . . . Le *minimum* de charbon mélange doit être employé. . . . Engagez, donc, ces Messieurs à faire des essais de cuites de soude *en diminuant progressivement le mixing-coal*.' . . . Je crois qu'ils obtiendront des résultats qui les interessont."

In France the proportion of mixing-coal used has long been reduced to about 30 per cent on the sulphate, and that is one reason why French black-ash has contained a smaller proportion of cyanides than English black-ash. But French black-ash, made with only 30 per cent of mixing-coal, still *does* contain cyanides. In adopting, however, the French proportion of mixing-coal, Mr. Mactear uses less limestone than the French use, and also a lower temperature. I have given above what seem to me strong reasons for doubting that his lower temperature will assist his object of avoiding "the necessity for destroying the cyanogen compounds" by "preventing their formation," and the fact that black-ash made with Mr. Mactear's proportion of limestone, but at the temperatures ordinarily employed, contains as much cyanides as black-ash made with larger proportions of limestone is certainly against the idea that his less limestone will be of much service towards the end now in question. But Mr. Mactear says in his communication to you that "actual working" by the method described had shown that, with "careful attention," preventing the formation of cyanides "is a comparatively easy matter." Had he not jumped to that conclusion somewhat too rapidly? When he was so good as to call on me at my hotel in Glasgow on September 1st he told me he had been working in the manner described for about a fortnight. Had he, when he wrote to you two days later, arrived at the stage of *finished ash*? Above all, had he, by the method described in his communication to you, obtained a finished product, *made without removing any red liquors*, and yet as free from iron and as good in colour as ammonia ash? M. Pechiney does that regularly at Salindres; and therefore no method of conducting the balling operation can have really substantiated its claim to be considered as good as Pechiney's, or to be regarded as putting an end to "the necessity for destroying the cyanogen compounds" which are the bane of ordinary black-ash, unless it shall have done that too.

That by reducing the mixing-coal to a minimum, employing a suitable furnace temperature (and I could give far more facts than I have given to show that a high one is the best), and bestowing upon the operation that "careful attention," the necessity for which it is so desirable to diminish rather than to increase, there is no doubt that black-ash can be got containing a very much smaller proportion of cyanogen compounds than ordinary English black-ash contains at present; but that it can be obtained by these or any other means except Pechiney's as free from cyanogen compounds as Pechiney's process yields it, is quite another question. And even if this question could be answered in the affirmative, I fail to see that anything would be gained. Pechiney's process does *not* require specially "careful attention," but offers a simple means by which any ordinary black-ash man can regularly produce black-ash free from cyanogen compounds, and this without one farthing of extra cost. At first, some of the English manufacturers who experimented with it failed to get by it as much work through their furnaces as they had been in the habit of getting, and found, or thought they found, that the process required more limestone than Mr. Mactear's licensees use. Now, however, the process is worked in England at a cost for limestone certainly not exceeding the cost of Mr. Mactear's limestone and lime, while neither the work got through the furnaces nor the lixiviation of the product leave anything to be desired. A cheaper means of dealing with the problem of the cyanogen compounds in black-ash is thus not conceivable; a more effective means is certainly impossible; and I have no doubt that, when the present excitement with respect to this subject shall have subsided a little, many who are now engaged in searching for some better process will begin to ask themselves what better, simpler, or cheaper process there could conceivably be than one which, when a charge of sulphate of soda has been converted into black-ash containing cyanide of sodium, converts both that cyanide and more sulphate into more carbonate of soda, at less expense than would be required for the conversion of the "after-charge" of sulphate into carbonate by any other method at present known?—I am, &c.,

WALTER WELDON.

Rede Hall, Burstow, Surrey,
September 10, 1878.

THE TELEPHONE RELAY.

To the Editor of the Chemical News.

SIR,—In your issue of July 26th, 1878, I notice the claim of Mr. Edison, of New Jersey, to the invention of the Telephone Relay, described by Prof. Thomson and myself in your issue of June 21st, 1878.

Mr. Edison, in his note to your paper, claims that "The telephonic repeater, described by Messrs. Houston and Thomson, in your issue of June 21st, was invented by me over a year ago." Now, since the invention of Prof. Thomson and myself consists in the application of the microphone of Prof. Hughes to the articulating telephone of Prof. Bell, it would appear singular, in view of the recent announcement of Prof. Hughes's discovery, that we should have been anticipated *a whole year* by Mr. Edison. It would seem, therefore, that before Mr. Edison can substantiate his claim to one particular form of Telephone Relay, that he must make good his claim to priority of invention of the microphone, and this he has certainly not as yet succeeded in doing.

As to Mr. Edison's further remarks, that "One of the many forms devised by me was published in the *Journal of the Telegraph*, &c," I would remark that, as far as I am aware, this is the *only form* of which we have any published accounts, and therefore the only one in which Mr. Edison can base his claims for priority of invention. Now, it would appear from a description of this instrument in the *Telegraphic Journal* of July 1st, 1877, that Mr. Edison calls his invention a Pressure Relay, and states that it is intended to be used in connection with his

Speaking Telegraph. So far as I can learn, this speaking telegraph *is not an articulating Telephone*, but a species of harmonic telegraph, in which vibratory pulses of electricity are employed, in a manner somewhat similar to the system devised by Gray. Nowhere in this article, or indeed elsewhere that I can find, does Mr. Edison claim that his invention can be applied to the relaying of the rapidly varying currents of the articulating telephone. It would appear to be only after the announcement of our invention that anything is heard of the possibility of using the Pressure Relay for this purpose.

Not only, then, has Mr. Edison failed to have anticipated us in the invention of the particular form of telephone Relay devised by us, but, it would appear that he has also failed to established his claim to the invention of any form of telephone relay.—I am, &c.

EDWIN J. HOUSTON.

Central High School, Philadelphia,
Aug. 22, 1878.

COMMERCIAL SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—As a practical commentary on the deliverance of "J. H." allow me to say that my firm (which is one of the largest makers in the country) turns out all its sulphate, by a mode of working of its own, in good merchantable condition, with only 24 per cent of ammonia.

If we produced it with the 24¼ per cent average, which "J. H." seems to think the consumer has a right to, we would be losing at the present moment about £20 to £30 per week. That there are any manufacturers doing this who have *nous* enough to regulate their process and make a decent use of their laboratories I am inclined to doubt. As long as only 24 per cent is guaranteed and paid for, it is probable the consumer will look in vain for a richer article. Immediately, however, the brokers consent to pay for another half or three-quarters per cent (as it is certainly to their clients' interest in mere carriage saving to do) a sulphate of 24·5 or 24·75 per cent will be forthcoming.

I know from former actual working that 24·75 can be made with ease without either the prolonged draining or artificial drying of "J. H." A previous correspondence in your columns struck a distinct blow at the other (I mean the colour) superstition. It is to be hoped that a second ventilation of the subject may suffice to give it the *coup de grâce*. It would be ludicrous if it were not melancholy that in this year of grace, 1878, manufacturers of sulphate should have to rack their brains, not to improve the quality of their product, but for a means of keeping down its proportion of valuable constituent; besides having to employ a comparatively costly acid to enable them to produce a "good grey" manure!

IN A FOG.

"MILLER'S CHEMISTRY."—PART II.

To the Editor of the Chemical News.

SIR,—Would you allow me space to correct a slight error which occurs in your kindly review of the new edition of "Miller's Chemistry," Part II., and also to offer a word of explanation? You say, "Strangely enough nothing is said of the liquefaction of hydrogen, nitrogen, and oxygen, by MM. Cailletet and Pictet." On p. 143 of the work, however, there is a footnote:—"Quite recently oxygen, hydrogen, and nitrogen have all been reduced to the liquid state. Oxygen was first liquefied by Pictet at −140° (−220° F.), under a pressure of 320 atmospheres. Almost immediately afterwards Cailletet announced that he had succeeded in liquefying nitrogen and hydrogen." And references to this are given in the Index under "Hydrogen," "Oxygen," and "Nitrogen." The explanation is simple enough: the first few sheets of the work had already been struck off when Pictet's discovery of the liquefaction of oxygen was announced, and the sheet containing an account of the properties of nitrogen was ready for press: fortunately, however, there was time to insert the short footnote above alluded to.—I am, &c.,

CHARLES E. GROVES.

MAGNETIC FIGURES.

To the Editor of the Chemical News.

SIR,—Since writing the note on this subject (CHEMICAL NEWS, vol. xxxviii., p. 20) I have been informed by Prof. Thompson that I was labouring under a misapprehension, and that he lays no claim to originality in the method of preparing the plates. I am also informed that these figures (which I have not yet seen) are original. Under these circumstances the remarks made in my note cease to have any meaning, and I therefore hasten to withdraw them.—I am, &c.,

ERNEST H. COOK.

Bristol, September 2, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 5, July 29, 1878.

New Communication on the Subject of the Notes on Alcoholic Fermentation found among the Papers of C. Bernard.—L. Pasteur.—The author complains that portions of these notes have been suppressed or even modified in the *Revue Scientifique*. He announces his intention of repeating the experiments of the late Claude Bernard.

Variations in the Intensity of Currents Transmitted through Imperfect Contacts, according to the Pressure Exercised upon them.—Th. du Moncel.—One of the most interesting manners of demonstrating the variations in the intensity of currents transmitted through imperfect contacts is to roll upon a glass tube a coil of copper wire (No. 16) deprived of any isolating covering, and adapting to the two ends of the tube two systems of screws with their threads arranged in such a manner that on turning and approaching each other they may compress the spiral longitudinally, and consequently effect a greater or less pressure of the turns against each other. When the pressure is very feeble the resistance of the wire of the helix is little inferior to what it would be if covered with silk, but it diminishes successively as the screws are tightened and the coils pressed against each other.

The Part Played by Coal-dust in Producing Explosions in Mines.—L. Simonin.—The author demands permission to make known certain facts which prove that it is in the majority of cases the heating of the coal-dust diffused in the galleries of the mines to which explosions are due. Referring to the catastrophe in the Jabin Mine at Saint Etienne (February 4, 1876) he states, on the authority of the manager, that the mine in question contains very little fire-damp, and that the precautions hitherto taken with an exclusive reference to that gas are not sufficient. Others must be taken against the extremely fine coal-dust, which at the moment of the explosion of slight amounts of fire-damp, or even of blasting powder, liberates rapidly a part of the coal-gas which it contains, and propagates the explosion, reproducing the cause

of the evil with so much the greater energy as the current of air is more violent. Thick crusts of coke (2 or 3 centimetres) prove this fact and explain how it is that extensive tracts in which fire-damp has never been observed are burnt like the rest of the workings. Hence, it appears that the precautions to be taken in fiery mines are complex whenever the coal-dust is rich in gas and very finely divided. Explosions may then ensue even in mines where fire-damp is unknown. There is no need to suggest the existence of cavities full of carbonic oxide, or of gaseous hydrocarbons, and suddenly laid open by a blow from the miner's pick. (Is not the attempt, recently made in some mines, to screen the coal below ground, a dangerous mistake as calculated to increase the quantity of dust diffused in the air of the mine?—*Ed.* C. N.

Non-existence of the Elongation of a Conductor Traversed by an Electric Current Independently of Calorific Action.—R. Blondlot.—The author finds that the passage of a current in a metallic conductor produces no mechanical effect, either of lengthening or shortening.

New Observations on Commercial Sub-nitrates of Bismuth.—A. Carnot.—An examination of a recent paper by M. Riche.

Thermic Formation of Phosphuretted and Arseniuretted Hydrogen.—J. Ogier.—The heat of the formation of phosphuretted hydrogen from its elements, $P+H_3$, is $+36{\cdot}6$ calories; that of solid hydrogen phosphide, P_2H, is $+66{\cdot}7$ cals.; that of hydrogen arsenide, AsH_3, $= -11{\cdot}7$ cals.

Researches on Amylic Alcohol: Dextrogyratory Alcohol.—J. A. Le Bel.—The rotatory power of commercial samples of amylic alcohol varies between $-1°$ and $-2°$ for 10 centimetres. The author has nevertheless found that on the distillation of low residual liquids, containing butylic and propylic alcohols boiling at 108° and at 98°, there is obtained as residue an amylic alcohol whose rotatory power is $-3°$ and even above. As these alcohols have the same source as ordinary amylic alcohol there is reason to admit that in the distillations of propylic and butylic alcohols the active amylic alcohol has been carried over in a larger proportion than its inactive isomer, whence it results that at a low temperature it must have a temperature much greater than the latter, and that the separation can be effected by distillation in a vacuum. By means of the action of moulds (*Penicillium*) the author has decomposed inactive amylic alcohol, and has obtained a mixture very rich in dextrogyratory alcohol.

Identity of Inulines from Different Sources.—MM. Lescœur and Morelle.—Contrary to the opinion of MM. Ferrouillat and Savigny the authors find the inulines obtained from elecampane, from the dahlia, and from chicory identical.

No. 6, August 5, 1878.

On Roasting Plasters, and on the Manufacture of Plasters which Set Slowly.—E. Landrin.—Plasters which have served once cannot be usefully roasted again, as it has been repeatedly proved. Gypsum heated to a temperature more and more elevated loses more and more its affinity for water, but retains the property of resuming its water of crystallisation. Plasters heated to redness and mixed with water in the ordinary manner no longer sets, but if, instead of being drenched with water, it is mixed with the smallest possible quantity of that liquid, say 33 per cent, it sets in ten or twelve hours, and becomes extremely hard. This fact, which has never before been observed, explains the action of the elevated temperature necessary for the manufacture of English cement.

Abnormal Solubility of Certain Bodies in Soaps and Alkaline Resinates.—A. Livache.—For some time substances have been met with in trade under the name of petroleum soaps, obtained by adding to the materials commonly employed in soap-making petroleum oils mixed with a certain proportion of Carnauba wax. If these products are submitted to a moderate heat all the petroleum present distils over and the soap remains unaltered. But if they are brought in contact with water they dissolve entirely, without separation either of the petroleum or of the Carnauba wax, even as an emulsion. Yet if we attempt to dissolve petroleum, either in soap at the moment when it forms a paste, or in soap-lye, we cannot succeed; petroleum is, *per se*, absolutely insoluble in that medium. It is therefore to the presence of Carnauba wax, added at the moment of the manufacture of these so-called petroleum soaps, that their singular solubility must be ascribed. Carnauba wax is a complex product; in contact with alkalies it becomes saponified, and yields as characteristic product melissic alcohol, which must be considered as the true cause of the phenomenon mentioned above. Petroleum and melissic alcohol mix in all proportions, and if the mixture is brought in contact with soap-lyes it dissolves at once. In like manner very small quantities of wood-spirit, amylic alcohol, &c., enable ordinary soaps to dissolve as much as 50 per cent of alcohol, the product obtained being entirely soluble in water.

Action of Zinc Chloride upon Methylic Alcohol: Hexamethyl-benzin.—MM. Le Bel and Greene.—The substance obtained by this reaction is identical with the hexamethyl-benzin of MM. Friedel and Crafts.

Influence of Atmospheric Electricity upon Vegetation.—L. Grandeau.—It has been long ago remarked that in the neighbourhood of an isolated tree deprived of branches to a great height vegetation developes feebly. In vines the shoots which extend under a tree rarely produce ripe grapes, though air and light circulate freely around them. Lofty trees bordering arable lands produce the same effects on the neighbouring crops. In forests of high growth the underwood has disappeared and the turf where it exists is formed by plants, which never acquire the luxuriant growth they do in the open country. These results are generally ascribed to deficient light, influence of green light which has traversed the leaves, spreading roots, &c. To these causes the author's experiments enable him to add absence of static electricity in the air in such situations.

Mr. Edison, by the intervention of M. du Moncel, presented to the Academy an apparatus which he has named microtasimeter, and which serves to measure infinitesimal degrees of temperature or of moisture.

Another apparatus presented by the same inventor is the electromotograph, which renders it possible to obtain, under the influence of an excessively small electric force and over circuits of very great length, mechanical effects without the intervention of any electro-magnetic organ.

MM. Chardin and Berjot presented to the Academy a new model of the microphone explorer applied to the detection of calculi in the bladder.

Moniteur Scientifique Quesneville.
August, 1878.

Means of Extracting and Recognising Morphia in cases of Poison.—Prof. Selmi.—In the detection of morphia in the viscera, ether dissolves a little of this alkaloid if the alkaline liquid is left for twenty-four hours in contact with ether. If the viscera are recent, morphia may be detected with certainty. Chloroform in the cold does not dissolve the morphia contained in the viscera. This solvent may be employed to separate a part of the cadaveric alkaloids and some other impurities. A portion of the morphia present in the viscera is decomposed during the operation. Purification with basic lead acetate and sulphuretted hydrogen is useful for decolourising the aqueous extract, but the precipitate of lead sulphide may retain a portion of the dissolved alkaloids. An amylic solution of tartaric acid may serve to remove certain cadaveric alkaloids accompanying the morphia. In the putrid viscera the morphia is decomposed, and seems to be replaced by a derivative which possesses certain of its

reactions, but which is deprived of the most characteristic. The detection of a derivative of morphia ought not to be considered satisfactory proof that the viscera contain this base. Half a m.grm. of morphia, dissolved in 4 or 5 drops of sulphuric acid, yields, on the application of heat, a violet liquid. When cold this solution gives the following reactions:—If saturated with bicarbonate of soda, nothing; but on adding a drop of tincture of iodine, a green colour. With a drop of chlorine water the violet passes to a cherry-red, which becomes green on neutralising with bicarbonate of soda. With a drop of the solution of lead tetrachloride, a cherry-red colouration, more intense than that produced with chlorine water, and also turning green with bicarbonate of soda. With bromine water the violet becomes almost blood-red, which turns to an intense green on saturation with bicarbonate of soda. With iodic acid the violet is intensified. With nitric acid the cherry-red first produced becomes yellow, and on saturation with ammonia turns to a brown. Red prussiate gives a fine cherry-red colouration, as does also sulphate of binoxide of manganese if the solution is diluted.

Chemical Industry at the Universal Exhibition of 1878 (continued).—A. Kopp.—The author describes, at great length, the improvements effected in a variety of the heavier chemical manufactures. There is an account of the preparation of fuming sulphuric acid, which is made no longer at Nordhausen, but near Pilsen and Elbogen, in Bohemia, where M. Stark possesses twelve establishments, with 110 furnaces, which employ yearly 72,400 retorts, and furnish about 34,000 quintals of acid. The residue obtained from the distillation of copperas is now utilised as colcothar. M. Winckler prepares fuming sulphuric acid on another principle. Concentrated sulphuric acid is resolved by heat into sulphurous acid, oxygen, and water. The latter is condensed, and the two gases being brought in contact with a porous body, such as platinised asbestos, re-combine, forming sulphuric anhydride. The platinised asbestos only requires to be heated to redness at the outset, and the heat evolved by combination maintains it afterwards at the necessary temperature. Bisulphate of soda, ferric or zinc sulphates may also be heated in place of sulphuric acid. There is then no occasion to dry the gases evolved. A furnace with five retorts treats 1800 kilos. of oil of vitriol daily, giving 1000 kilos. of sulphuric anhydride, which, if dissolved in 1500 kilos. of acid, at 66° B., produces 2500 kilos. of a fuming acid containing 85 per cent of SO_3. The section on chlorine and chloride of lime contains a discussion of the processes of Weldon and of Deacon, the latter of which is still characterised as practically unavailable, notwithstanding the ingenious attempts made by the author to overcome its besetting difficulties.

Danger in the Use of Tempered Glass.—M. J. Laurent.—A capsule of a medium size was in use in the laboratory of M. F. Fournier, at Marseilles, and was employed, along with porcelain capsules, in determining the moisture of fatty substances. After being in use for a month, it was one day heated to 110° over a gas-stove, and kept at that temperature till its contents ceased to bubble. When cool enough to be handled it was transferred to the pan of a balance; but on touching the metal it burst with explosive violence, and its contents were projected to a distance. The operator was fortunately on his guard, and escaped with some slight burns. The author asks what would have been the result if the capsule had contained an acid or a concentrated alkaline solution?

Berichte der Deutschen Chemischen Gesellschaft zu Berlin. No. 9, 1878.

Action of Dehydrating Agents upon Anhydrous Acids (Fourth Communication).—S. Gabriel and A. Michael.—An investigation of phthallyl-acetic acid; of the action of sodium-propionate upon a mixture of phthalic acid and propionic anhydride; of sodium acetate upon a mixture of phthalic anhydride and phenyl-acetic acid.

The Solution-Heats of the Dithionates, the Nitrates, and the Sulphates.—Julius Thomsen.—A series of tables.

On Thialdehyds,—H. Klinger. (See *Ber.*, x., p. 1877, and xi., p. 1893).—The determinations of the vapour-density of β-acethialdehyd have given the peculiar and unexpected result that it possesses the same molecular formula as the thialdehyd discovered by Weidenbusch, the density of which was determined by Hofmann as 6·27 (as compared with air).

On Atmospheric Hydrogen Peroxide.—Em. Schöne (Fifth Communication).—In the strata of the atmosphere accessible to investigation there appears a larger quantity of vaporous hydrogen peroxide the higher the sun rises above the horizon, both during the day and during the year, and the smaller obstructions the sun's rays encounter in their passage through the atmosphere. The author considers it very probable that the proportion of hydrogen peroxide in the atmosphere will generally increase as we approach the Equator.

On a New Constituent of Coto Barks.—Jul. Jobst and O. Hesse.—The compound in question is an acid, $C_8H_6O_4$, and is identical with piperonylic acid.

On Certain Derivatives of Dimethyl-hydroquinon.—J. Habermann.—An examination of the chlorine-substitution products, of the bromine, and nitro-derivatives.

On Certain Derivatives of Dimethyl-resorcin.—M. Honig.—Also a notice of chlorine, bromine, and nitro-derivatives.

On Substituted Benzaldehyds.—C. Loring Jackson and J. Heming White.—An examination of parachlorbenzaldehyd, parabrom-benzaldehyd, and paraiod-benzaldehyd. All these compounds, on treatment with sulphuretted hydrogen, form reddish white, varnish-like, thio-compounds.

Reaction of Potassium Cyanide upon Dichloracetic Ether.—A. Claus.—The writer points out an error of Schiff's in the last issue of the *Berichte* (x., p. 810).

On Azoxy-, Azo-, and Hydroazo-Compounds.—H. Limpricht. — An examination of meta-azoxy-sulphobenzolic acid, of hydro-azo-sulphobenzolic acid,—a compound formed of treating the foregoing with stannous chloride,—of meta-azo-sulphobenzolic acid, and hydroazo-sulphobenzolic acid.

On Hexoylen from Mannite.—Otto Hecht.—Hexoylen is a colourless, mobile liquid, of penetrating, unpleasant odour. It is optically inactive; has at 0° the sp. gr. 0·7494; does not congeal in a mixture of salt and snow, and boils between 80° and 83°. Its composition is expressed by the formula C_6H_{10}.

Contributions to the Synthesis of Phenylated Fatty Acids.—Max Conrad.—An account of the preparation and properties of benzyl-acetic-ester, methyl-benzyl-acetic-ester, methyl-benzyl-acetic acid, methyl-benzyl-acetic-benzyl-ester, ethyl-benzyl-acetic-ester, and benzyl-acetsuccinic-ester.

On Isoxycuminic Acid from Carvacrol.—Oscar Jacobsen.—An examination of sulphocuminic acid, isoxycuminic acid, and their salts.

On a Bromated α-Metaxylol-sulphonic Acid.—E. Weinberg.—A dilute solution of α-metaxylol-sulphonate of baryta was gradually mixed in the cold, with the corresponding quantity of bromine. The precipitate deposited was trifling, and the filtrate on evaporation yielded a bromated barium-salt—monobrom-α-meta-xylolsulphonate of barium.

On Bibrom-naphthoquinon and Bromonaphthalic Acid.—Th. Diehl and V. Merz.—Chloronaphthalic acid has been employed as a colouring-matter, and was pre-

pared on the large scale according to a method derived from Laurent's process. The author has prepared the analogous compound, bromonaphthalic acid, and describes its reactions and certain of its salts.

On a Compound of Cobaltous Chloride with Aniline.—E. Lippmann and M. Vortmann.—A red salt which at 100° turns blue, and has then the composition—

$$2C_6H_7N + CoCl_2.$$

Characteristics of the Two Nearer Derivatives of Milk-Sugar.—H. Fudakowski.—This memoir is not adapted for abstraction.

On Measures and Weights of Rock Crystal.—H. Buff.—The author contends that the charges brought against platinum are of no importance.

On Rosanilin.—E. and O. Fischer.—The authors infer that rosanilin is simply triamido-triphenyl-carbinol.

Ammoniacal Derivatives of Isatin.—E. von Sommaruga.—The substances obtained from isatin by the action of ammonia under pressure are a diamid of isatin distinct from Laurent's imesatin, and two bodies which he names oxydiimido-diamido-isatin and desoxyimido-isatin.

Action of Bromine on Pyromucic Acid.—P. Tönnies.—The author has obtained and described pyromucic ether tetrabromide, pyromucic acid tetrabromide, and dibrom-pyromucic acid.

Remarks on M. Barth's Paper on Invertin.—E. Donath.—The author regrets that Barth has represented his results on this subject as differing so essentially from his own.

Chlorodinitro-cymol, Bromdinitro-cymol, and the so-called Solid Nitro-cymol.—E. v. Gerichten.—The author's dinitro-chlor-cymol is isomeric with Ladenburg's dinitro-chlor-cymol from dinitro-thymol.

On Aniline-Black.—R. Nietzki.—The author finds that if the acid is left out of regard, the formulæ for aniline-black—as proposed by Goppelsröder, Keyser, and himself—all correspond to the simplest expression C_6H_5N, thus comfirming his view that aniline black is formed from aniline by the elimination of a molecule of hydrogen. The salts of aniline black lose a part of their acid either on washing with water or on drying strongly. The author dried the hydrochlorate at 100°, and obtained 11·6 to 11·8 per cent Cl. Goppelsröder dried at 110°, and obtained only 8·9. He had, on a former occasion, described a substance found present in aniline black, and characterised by dissolving in chloroform with a blue colour. This compound is readily formed by the oxidation of the salts of orthotoluydin. Its salts are green, but the free base is of a violet-blue, sparingly soluble in alcohol, but readily in chloroform and aniline. Its composition is C_7H_7N. Aniline black is formed by the action of almost all oxidising agents upon salts of aniline in an acid solution, the presence of metallic salts being by no means necessary. It is the representative of a whole series of similar bodies. The author then speaks of a product of the action of chromic acid upon aniline black, technically known as black that does not turn green. If the base of aniline black or one of its salts is treated with solution of potassic bichromate, a violet-black product is formed, which is no longer turned green by diluted acids. It shows much resemblance with the orginal base, but on friction assumes a yellowish metallic lustre. Goppelsröder ascribes to this compound an additional atom of oxygen. The author finds that it contains a considerable quanity of chromic acid, 8·17 per cent, whence he concludes that it is the chromate of the base aniline black.

Remark on Violacein and Eupitton.—C. Liebermann. The author, in reply to a passage from Grätzel, in Wagner's *Annals of Chemical Technology*, 1878, p. 940.* declares that he has never pronounced violacein identical with eupitton. The technical value of violacein he considers doubtful.

Certain New Compounds of Boron.—C. Councler.—The author describes ethylen-mono-borate, iso-propyl-borate, the action of anhydrous boric acid upon secondary caprylic alcohol and boroxy-trichloride.

The Steric Law.—H. Schrœder.—In a memoir laid before the Academy of Sciences at Munich, December 1, 1877, the author has established the "steric law" to this effect:—In every solid compound there predominates the volume-measure, *i.e.*, the stere of one of its elements, which, by means of the forces effective in crystallisation, determines all the other components and elements to adopt the same volume-measure, the same stere. With this law the way is opened for the determination of the volume-molecules of solid bodies. For this so many atoms of an element or of a compound must be taken, but not more than are necessary, in order that the volume of each element alone, or in combination, may be expressed as a whole multiple of the predominant stere. In other words, the solid molecule of each element contains only whole volumes or steres. Thus, *e.g.*, the solid molecule of zinc and zinc oxide = Zn_3 and Zn_3O_3, because three atoms of zinc alone, and in the oxide, take up the space of five volume unities or steres, and the three atoms of oxygen 3 steres. The author indicates the number of atoms of each element in a compound, as customary with a whole number on the right hand and below, along with the symbol of the element, and the number of its steres with a whole number to the right hand above. He gives prominence to the stere by a line above the figures, and to the volume observed and calculated by a line below the figures. In a compound he indicates that element which determines the stere by a line above it. If the atomic weights are expressed in grammes, the steres and the volumes will be cubic centimetres. Thus metallic silver is $\overline{Ag^2_1} = 2 \times \overline{5{\cdot}14} = 10{\cdot}28$, observed vol. $= \underline{10{\cdot}28}$, *i.e.*, an atom of silver, or 108 grms. occupy the space of 10·28 c.c., *i.e.*, twice 5·14 c.c. or two silver steres. Silver chloride, bromide, and iodide are—

$$\overline{Ag^2_1Cl^1_1} = 5 \times \overline{5{\cdot}14} = \underline{25{\cdot}70} \text{ observed } \underline{25{\cdot}7}$$

$$\overline{Ag^2_1Br^1_1} = 6 \times \overline{5{\cdot}14} = \underline{30{\cdot}84}$$

$$\overline{Ag^2_1I^1_1} = 8 \times \overline{5{\cdot}14} = \underline{41{\cdot}12}$$

In all three compounds the silver stere predominates; they contain silver with 2 steres, its metallic volume; chlorine with 3, bromine with 4, and iodine with 6 silver steres.

Contributions to the Steric Laws.—H. Schrœder.—The author applies his law to a number of compounds belonging to different groups.

* *Jahresbericht der Chemischen Technologie.*

MISCELLANEOUS.

American Association for the Advancement of Science.—Dr. H. Carrington Bolton, the Permanent Secretary, kindly sent us from St. Louis the daily programme of the twenty-seventh meeting of the above Association, which commenced on August 21st last. The names of the President and Officers we gave in our issue of June 21st. The following is a list of the papers brought before the Chemical Section:—

Ellen S. Richards and Alice M. Palmer—Notes on Antimony Tannate.

Prof. F. W. Clarke—The Electrolytic Estimation of Mercury.

Prof. F. W. Clarke—Some New Seleno-cyanates.

Prof. F. W. Clarke—Some Specific Gravity Determinations and Conclusions from them.

Prof. J. Lawrence Smith—A Short Account of the Nature of Oxide of the New Element Mosandrum.

Prof. J. Lawrence Smith—The New Meteoric Mineral Danbrulite, and its Frequent Occurrence in Nature in Meteoric Iron.

B. S. Hedrick—On the Development of Ozone in the Air by means of Sudden Changes of Temperature.

A. P. S. Stuart—Electricity an Agent in Vegetable Growth.

Among the papers read before the Physical Science Section we notice the following:—

Prof. G. F. Barker—On the Results of the Spectroscopic Observations of the Solar Eclipse of July 29, 1878.

Prof. G. F. Barker—A New Method of Determining the Pitch of the Tuning Fork.

T. A. Edison—A New Voltameter.

T. A. Edison—On the Principle Involved in the Microphone and the Carbon Telephone.

Ormond Stone—On the Possibility of Observing the Solar Corona without the Aid of an Eclipse.

B. S. Hedrick—On the Development of Ozone in the Air by Means of Sudden Changes of Temperature.

P. H. Van der Weyde—On a Modified Form of Telephone Intended for a Sensitive Electroscope for the Detection of Feeble Currents.

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August, 1878. JAMES B. SIMONDS, Principal.

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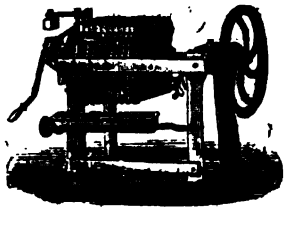

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Vol. XXXVIII. No. 982.

ESTIMATION OF LEAD AS IODATE.*

By CHARLES A. CAMERON, M.D.

The author found that plumbic iodate was practically absolutely insoluble. Iodic acid and alkaline iodates precipitate lead far more perfectly than sulphuric acid, even when alcohol is added to the latter. The plumbic iodate formed is weighed, or, if a volumetrical inertia be desired, the following is the process:—Precipitate with standard solution of soluble iodate, and filter off the plumbic iodate. The filtrate and washings are to be mixed, and the excess of iodic acid contained in them estimated volumetrically by the hydrochloric acid and hyposulphate method. As it is almost impossible to procure pure iodic acid or potassium iodate, the solution of iodate must be standardised by means of a solution of pure nitrate of lead. Owing to the slight solubility of plumbic iodate in alkaline chlorides, iodides, and bromides none of these salts must be present. HCl rapidly dissolves iodate of lead.

ON SULPHUR AND PHOSPHORUS IN IRON.

By SERGIUS KERN, M.E., St. Petersburg.

It is a well-known fact that sulphur and phosphorus are diffused very unequally in iron and also in steel. The author had an opportunity of analysing a piece of square iron (1" × 1") for sulphur and phosphorus, taking shearings from this bar in different places, which for this purpose was divided through its length into seven equal parts. The length of the bar was 44 inches. The following results of the analyses of these shearings may be of some interest:—

	Sulphur. Per cent.	Phosphorus. Per cent.
1.	0·041	0·031
2.	0·042	0·025
3.	0·060	0·045
4.	0·055	0·026
5.	0·059	0·034
6.	0·042	0·037
7.	0·036	0·025

The sulphur was estimated as barium sulphate, and the phosphorus by the method of Eggertz.

GLUCOSE REACTION.

By DAVID LINDO.

If the yellow crystalline compound obtained by the action of nitric acid on brucine (Chemical News, vol. xxxvii., p. 98) is dissolved in a solution of potash or soda, a fluid is obtained which glucose, owing to its action as a reducing agent, changes from yellow to intense blue.

To show this reaction, dissolve half a grain of the substance in one fluid ounce of liquor potassa, B.P. Place about 60 minims of the amber-coloured solution thus obtained in a moderate sized test-tube, heat to boiling, then add two or three drops of a dilute solution of grape-sugar. The colour of the fluid will change almost immediately to intense blue. Cane-sugar has little or no action on the test. This is a very beautiful reaction, and the method of obtaining it one of easy application. I had hoped to render it available as a means of testing for sugar in urine, but it appears of little value for this purpose, as the normal constituents in urine are not without action on the reagent. Every sample of urine tried was found to produce a change of colour more or less intense when heated with an equal volume of the test fluid prepared as above. The following method was then tried:—40 to 50 minims of the solution (half grain to the fluid ounce of liquor potassa) was placed in a test-tube 4½ × ½ inch, heated to boiling, and two or three drops of the urine added. The tube was then slightly shaken, and held between the light and eye.

120 specimens of human urine, free from sugar and apparently otherwise healthy, examined in this way gave the following results:—

98	No notable change.
12	Decided darkening of the test fluid.
8	Decided change to green.
2	Decided change to blue.
120	

But the urinometer showed the test to be of little practical value, even as regards negative results thus obtained with it, though the above figures might seem at first to indicate the contrary. The sp. gr. of those urines which produced no notable change was rarely as high as 1020, and ranged chiefly between 1012 to 1016. In urines of this moderate density it is known sugar is rarely found, and it is therefore seldom looked for. The sp. gr. of the urines which caused decided darkening or change of colour with the test, ranged between 1020 to 1030. Some of these were diluted with an equal volume of water, and two or three drops tested again as above, when in most cases no appreciable change of colour was observed. A few specimens that of themselves produced no change, were mixed with grape-sugar in various proportions, and two or three drops tested with the following results:—

½ gr. sugar to 1 fluid ounce of urine.—Change to green, not intense.

1 gr. sugar to 1 fluid ounce of urine.—Change to intense green.

*2½ grs. sugar to 1 fluid ounce of urine.—Change to intense blue.

Ordinary diabetic urines containing from 5 to 10 per cent of sugar would therefore, even if diluted with 10 to 20 parts of water, give a very decided reaction with the test. As the method is one of easy and rapid application it may sometimes prove useful as a preliminary step in the examination of such urines. Reaction obtained with it, however decided, would require confirmation by other means.

No appreciable change of tint would indicate that sugar is absent, or, if present, that the quantity is less than a grain to the ounce of urine; but this result, as the above experiments have shown, will rarely be obtained with urines of high density, though sugar may be altogether absent. The results obtained in the following experiments may prove of some interest:—

1. Fresh healthy urine was mixed with 2 per cent of grape sugar; 2 drachms of the mixture placed in a small filter made of parchment paper, and dialysed into about 7 drs. of distilled water contained in a rather narrow 1 ounce beaker. The filter rested in the mouth of the beaker, and the external water was quite up to the rim. (Temp. 85° F.). At the end of an hour 30 minims of the external water heated with the same volume of test fluid changed it to intense green.

* Abstract of a paper read before the Society of Public Analysts' Dublin, September 19, 1878.

* Two grains of sugar to an ounce of urine will generally be found sufficient to produce intense blue reaction.

2. Urine mixed with 4 per cent of sugar afforded a very decided blue reaction in an hour under the same treatment.
3. Urine entirely free from sugar, but which reacted rather strongly on the test when applied direct, was dialysed in the same way for twenty hours, but the external water at the end of that time failed to produce the slightest change of tint when heated with an equal volume of the test fluid. It had been tested at intervals during the process with the same result.

I believe no urine free from sugar would afford reaction under this treatment, but of course further experiments are required to confirm this. On the other hand, only such urines as contain notable quantities of sugar would furnish proof of its presence in one or two hours by the process, which for obvious reasons could not be greatly prolonged.

Falmouth, Jamaica, August 20, 1878.

Note.—The deep blue colour produced by the reagent is not very permanent at any temperature, and disappears rather quickly at or near the boiling-point of the fluid. It remains visible, however, quite long enough for all necessary purposes of observation. The test fluid is to be brought to the boil, but not kept boiling for any length of time before adding the fluid to be tested, nor is the mixture to be boiled again after the fluid that is being tested has been added.

ANALYSIS OF BEHAR OPIUM-ASH.

By C. J. H. WARDEN, Surgeon H.M.S. Bengal Staff, Off. Principal Assist. Opium Agent, Behar.

The following is the result of an analysis of opium-ash, obtained by preserving the ashes of all samples of Behar opium analysed at the Government Opium Factory, Patna, for some years past.

Fe_2O_3	1·9839
Al_2O_3	traces
Mn_3O_4	traces
CaO	7·1344
MgO	2·3104
K_2O	37·2405
Na_2O	1·7006
SO_3	23·1419
P_2O_5	10·9021
CO_2	traces
Cl	traces
SiO_2 and sand	15·2740
	99·6878

The ash was of a very light grey colour, and contained 0·8575 per cent of charcoal, which was deducted before calculating its percentage composition. It yielded to boiling-water 58·4961 per cent of soluble salts. The aqueous solution gave marked indications of the presence of SO_3, P_2O_5, and K_2O.

The large amount of SO_3 present in the ash is noteworthy. The acid is usually considered to be in combination with potash and lime. According to Christison, sulphuric and meconic acids are the solvents of the active principles of opium. Bilty, in *Buchner's Repertorium*, xxxix., quoted by Christison in his "Dispensatory," gives 2 per cent as the amount of sulphate of potash contained in Turkey opium. Sulphuric acid is also a constituent of the poppy plant ash. Mr. John Scott, in his "Manual of Opium Husbandry," gives analyses of poppy plant ash, in which the SO_3 varies from 5·93 to 10·08 per cent. And Mr. Scott points out that the larger the amount of sulphuric acid in the plant, the smaller is the yield of morphia, thus—

SO_3 in Plant-ash.	Morphia in Opium.
5·93 per cent	8·66 per cent
7·64 ,, ,,	6·47 ,, ,,
10·08 ,, ,,	4·65 ,, ,,

It would be interesting to ascertain whether or not there is a similar correlation between the SO_3 in opium-ash and the amount of morphia contained in the drug. Possibly the SO_3 in opium may be directly proportional to its richness in morphia.

The iron present in opium-ash is doubtless introduced by the abrasion of the iron instruments used for scarifying the poppy capsules, and for collecting the exuded juice.

Patna, September 20, 1878.

ON THE EXTRACTION OF IODINE AND BROMINE FROM KELP.*

By ROBERT GALLOWAY, F.C.S., Professor of Chemistry in the Royal College of Science for Ireland.

Having had, some time ago, facilities for becoming completely acquainted with the manufacturing processes followed for the extraction of iodine, bromine, and the potash salts from kelp, I devoted a considerable portion of time to the study of this branch of manufacturing industry. It is one of the manufactures which ought to flourish in Ireland, owing to the large quantity of the raw material (sea-weed) which can be obtained in this country. I am sorry to have to state that there is now no kelp factory in Ireland; the only buyers of Irish kelp at the present time are the Scotch manufacturers.

The description in works on Chemistry of the processes followed for the extraction of the kelp products are very meagre in a manufacturing point of view, especially as regards the extraction of the two most valuable substances, iodine and bromine, and these two substances are the most difficult to extract with manufacturing success. The descriptions state that such and such processes are followed; but important details are altogether omitted, as, for instance, the conditions most suitable for carrying out the processes successfully, and the different precautions which ought to be observed.

Iodine was at one time a monopoly. The iodine manufacturers combined together not to sell this substance under a certain price; which, like all other monopolies, had the effect of impeding rather than of promoting improvement in this branch of manufacture. The monopoly exists, I believe, no longer: new sources of supply of the substances I have termed kelp products—iodine from the mother-liquors obtained in refining the nitrate of soda in Peru, bromine and potassic chloride from the salt beds in Prussia—have not only extinguished it, but have also rendered necessary the adoption of superior and more economical methods in the extraction of these substances from kelp, for the continuance of kelp being employed as a raw material.

Many methods have been proposed for the extraction of the two metalloids, iodine and bromine, from the ash of sea-weed; but the only one, as far as I am aware, which has been followed in the United Kingdom, at least up to a very recent period, is the one ascribed to Wollaston. By this method they are set free from the metals with which they are combined by the addition of sulphuric acid and manganese peroxide to the mother-liquor which remains after the extraction (of course as far as it is practicable) of potassic sulphate and chloride, and what are termed the kelp salts, which are a mixture of sodic sulphate, carbonate, and chloride.

* A Paper read before the Royal Irish Academy, April 8, 1878.

The sulphuric acid is added for a twofold purpose: a portion is required for the decomposition of the alkaline sulphides, sulphites, and hyposulphites, present in the mother-liquor; the other portion, along with the manganese oxide, liberates the iodine and bromine from their combinations. When the sulphur which is set free from the decomposition of the hyposulphites has completely deposited, the clear liquid is drawn off into the iodine still, and the manganese peroxide is then added to it.

When this process first came into operation, bromine had not been discovered in the ash of sea-weed; even the late Dr. Anderson, in his well-known and often quoted analyses of the ash of sea-weed, does not give it as a constituent. New analytical investigations of the ash of the various sea plants are wanted; the plants ought to be carefully freed, before incineration, from all adhering salt water, so that the quantities of chlorine, bromine, and iodine they naturally contain might be correctly ascertained. The investigation would lead, most probably, to the discovery that there are, properly speaking, *bromine* as well as iodine producing plants.

The three metalloids are each liberated from their metallic combinations by the manganese peroxide and sulphuric acid, but owing to their different degrees of affinity for metals—chlorine having the strongest, and iodine the weakest affinity—the latter is the first set free; but it requires the greatest care and attention to prevent some portion of the other two from being set free at the same time. If this occurs, they enter into union with one another, forming volatile compounds which affect the eyes, and have a very pungent odour. The liberation of the bromine or chlorine, or both, during the extraction of the iodine may occur, for instance, from the manganese oxide becoming unequally diffused in the liquid; they will also be liberated if the temperature of the liquid becomes too high; and it appears to me highly probable that the influence of *mass* will also cause their liberation, especially when the quantity of iodine becomes, by volatilisation, much decreased in quantity. That they are liberated to some extent during the distillation of the iodine is at once perceived by those who visit the still during the distillation, and who are acquainted with the properties of these compounds. I may here observe that the still-man judges whether at least an undue proportion of the other two are volatilising by the colour of the vapour; if it is of a brownish or whitish colour he is aware he is losing iodine. When the distillation is finished, and the still head removed, the vapour which escapes from the still has always a violet colour, and some iodine always remains in the liquid; for if the distillation were continued until all the iodine had volatilised, there would be evolved along with it in the last stages one or both of the other metalloids in somewhat large proportions; and consequently there would be a loss instead of a gain in iodine. These are some of the imperfections and difficulties of Wollaston's process.

The extraction of bromine follows the extraction of iodine, the same process being adopted, and similar precautions have to be observed.

It is evident such a process is unsuitable for the extraction of valuable substances like iodine and bromine, and it may also be observed that the liquid from which they have been volatilised has to be thrown away, on account of the difficulty of utilising it, although it contains a large quantity of potash salts and all the sulphuric acid employed in the extraction; the money value of which is estimated to be nearly one-half of the whole cost for extracting all the products from the kelp.

Chlorine is the agent, out of the many proposed as substitutes for the manganese oxide and sulphuric acid, which I would recommend, but under conditions somewhat different from those I have seen described; this difference in the conditions would render the process more exact, and better results in every respect would be obtained. The kelp solution I would render neutral by the addition of sulphuric acid before adding an aqueous solution of chlorine; and as I have found by investigation that the kelp solution contains clay, and as this substance tends to render the solution viscid and unfavourable for crystallisation, I would, before evaporating to obtain the last crop of potassic chloride, nearly neutralise the liquid so as to get rid of it. Although a little more acid would be consumed than if it were all added in the ulterior stage, the disadvantage would be more than compensated by the larger crop of crystals of potassic chloride which would be obtained and the greater concentration of the liquid. After the extraction of the last crop of potassic chloride, I would neutralise the liquid exactly, and then place it in a graduated vessel; I would then add to a small measured portion of it some bisulphide of carbon, and finally some chlorine water from a graduated vessel, until the violet colour just disappeared. This is a process frequently employed for the estimation of iodine, and occupies only a minute or two. Having ascertained the exact quantity of chlorine water which decolourises the iodine—that is, converts it into pentachloride of iodine—it would only remain to add to the larger measured quantity of the liquid containing the iodine one-sixth of the relative quantity of the chlorine water which was required on the smaller scale. The small portion of iodine which would remain dissolved in the liquid, owing to its slight solubility in water, I would remove either by bisulphide of carbon or benzol. After the removal of the iodine, I would treat the liquid with chlorine water, with similar precautions for the removal of the bromine; but as the compound of chlorine and bromine is a monochloride, one-half, and not one-sixth, as in the case of the iodine, of the relative quantity of chlorine water would have to be added to the larger measured portion of the liquid.

If, in any case, it should be found desirable not to precipitate the entire portion of the iodine and bromine with chlorine water, on account of rendering the liquid too dilute, a portion might first be precipitated by chlorine gas, and the remainder by means of chlorine water in the way I have described.

This method would not only be speedy, but exact, for it would be the conversion of a quantitative analytical operation into a manufacturing process. After the removal of the bromine, the alkaline salts which remained in solution could be easily recovered.

It would be necessary to sublime the precipitated iodine.

ON THE

DETERMINATION OF SULPHUR IN COKE.

By W. A. BRADBURY.

THE sulphur in coke is usually determined, either by boiling with nitric acid and potassic nitrate or by fusing with potassic nitrate, sodic carbonate, and salt.

I was induced to go into the following experiments by the fact that boiling nitric acid and aqua regia and potassic chlorate gave results considerably below those obtained by fusion.

Percy (*Fuel*, p. 274) says, "Sulphur is always present in coal. It may exist in the state of sulphuric acid in combination with a base; in combination with iron as iron pyrites or bisulphide of iron; and doubtless also in combination with the organic elements of coal, as it exists, for example in hair. It chiefly occurs in the state of iron pyrites, from which no coal is entirely free. In the sequel (p. 344) analytical evidence will be given in support of the above statement, that sulphur is present in some varieties of coal in what may be designated a state of organic combination, but what the definite compound may be which contains it is unknown." Turning to page 344 we find the following:—

Coal from New Zealand.

Carbon	79·00
Hydrogen	5·35
Oxygen	7·71
Nitrogen	0·89
Sulphur	2·50
Ash	3·50
Water	1·05
	100·00

From the west coast of Middle Island. This coal is black, firm, and uneven in fracture. Colour of the ash, remarkably white. Coke contains 2·35 per cent of sulphur. No sulphuric acid was detected in the hydrochloric acid, in which the powder of the coke had been boiled. It would appear that the sulphur was present in the same state of combination in the coal as that in which it exists in albumen, fibrin, &c.; for it could not have been combined with iron, as in that case the ash would have had a decided red colour." On p. 326 he also gives a table of South Staffordshire coals, as below:—

Carbon.	Hydrogen.	Oxygen and Nitrogen.	Sulphur.	Sulphur to form Pyrites with Iron.	Total Sulphur in Coal.
76·12	4·83	16·10	0·63	0·37	1·00
77·01	4·71	16·35	0·60	0·14	0·74
76·40	4·62	17·23	0·52	0·34	0·55
72·13	4·32	16·88	—	1·08	0·54

From this it will be seen that there may be considerably more sulphur existing in organic combination (?) than in the form of pyrites. The same thing is shown in the following analyses of Dowlais coals and ashes, taken from pages 325 and 352 Percy's "Fuel." The C, H, O, N are omitted.

Coals.

Sulphur	0·55	1·01	1·07	1·22
Ash	1·20	2·00	3·32	7·18

Ashes.

Silica	35·73	24·18	37·61	39·64
Alumina	41·11	20·82	38·48	39·20
Ferric oxide ..	11·15	26·00	14·78	11·84
Lime	2·75	9·38	2·53	1·81
Magnesia	2·65	9·74	2·71	2·58
Sulphuric acid ..	4·45	8·37	0 29	—
Phosphoric acid ..	0·99	0·21	2·00	trace
Ferrous sulphide ..	—	0·38	—	—

Calculating the ash into its constituents the coals then become—

	I.	II.	III.	IV.
Sulphur	0·550	1·010	1·070	1·220
Silica	0·434	0·484	1·269	2·902
Alumina	0·499	0·421	1·298	2·889
Ferric oxide ..	0·135	0·417	0·498	0·858
Lime	0·033	0·188	0·085	0·132
Magnesia	0·032	0·196	0·091	0·179
Sulphuric acid ..	0·052	0·169	0·009	trace
Phosphoric acid ..	0·012	0 004	0·006	0·220

Calculating the iron to pyrites and the lime to sulphate we have—

No.	As Pyrites.	As Sulphate.	Calculated Total Sulphur.	Sulphur in Coal.
I. ..	0·104	0·020	0·124	0·55
II. ..	0·334	0·114	0·448	1·01
III. ..	0·389	0·049	0·438	1·07
IV. ..	0·686	0·075	0·761	1·22

The following is an extract from a paper read before the Chemical Society, June 7, 1877, by J. W. Thomas, "On the Gases enclosed in Lignite Coal and Mineral Resin of Bovey Neathfield." "Four samples were examined, two of which contained much hydrated oxide of iron in the cleavages. The gases consisted of carbonic acid, carbonic oxide, nitrogen, sulphuretted hydrogen. In one case sulphur was sublimed off in yellow crystals; organo-sulphur compounds, mercaptan, sulphide of allyl, &c., were also found in the gases. It seems probable that the iron pyrites of true coal have derived their sulphur from that existing in organic combination in the plants from which coal is produced."

From these examples I think that it will be allowed that a large amount of sulphur in coal may exist in organic combination.

The sulphur in coke is generally supposed to exist as sulphide of iron; but I think that from Table II. it will be seen that the sulphur can exist in another state of combination. It will be noticed that only small quantities of sulphuretted hydrogen is evolved on treating with dilute hydrochloric acid; also that all the iron in the coke is dissolved out by dilute acid, thus proving the absence of both protosulphide and bisulphide of iron. Only a trace of sulphur as sulphate exists in them. It would therefore appear to be in organic combination.

It will also be noticed that the amount dissolved out by acids is considerably lower than that obtained by fusion. That the same result is not always obtained when using the acid process is shown by Crossley (Crookes's

TABLE I.

No.	Weight taken. Grms.	Sulphur. Per cent.	Remarks.
1.	3·0000	0·204	Boiled with aqua regia and potassic chlorate.
2.	1·0000	0·212	Ditto Ditto
3.	1·3734	0·210	Ditto Ditto
4.	1·0000	0·233	Boiled with nitric acid and potassic chlorate.
5.	1·3734	0·205	Ditto Ditto
6.	2·7468	0·340	Boiled with aqua regia and potassic chlorate.
7.	2·7468	0·334	Boiled twice with aqua regia and chlorate.
8.	2·0000	0·395	Boiled with potassic nitrate and nitric acid.
9.	1·5000	1·162	Fusion.

Method.—The finely divided coke was boiled with the acid, evaporated to complete dryness, taken up with hydrochloric acid, filtered, and the sulphate precipitated with barium chloride. The numbers connected by a bracket are the same coke.

TABLE II.

Name of Coke.	Marley Hill.	Throckley.	Consett.	Hamsterley.	Conswood.
	P. c.	P. c.	P. c.	P. c.	P. c.
Sulph. evolved as H_2S	0·114	0·063	trace	0·084	0·013
Do. as sulphate ..	0·018	nil	trace	trace	trace
Do. dissolved by aqua regia and $KClO_3$ ..	0·263	0·261	0·119	0·290	0·186
Total sulphur by acid	0·395	0·324	0·119	0·374	0·199
Sulphur by fusion ..	1·163	0·976	0·577	0·814	0·887
Difference between fusion and acid ..	0·768	0·652	0·458	0·440	0·688
Ash	7·930	7·220	6·910	7·280	9·000
Iron in ash	1·162	1·956	1·071	0·994	1·127
Iron dissolved by dilute HCl	1·306	1·880	1·283	1·166	1·703

Method.—The finely powdered coke was boiled with dilute hydrochloric acid and the H_2S absorbed by means of ammoniacal solution of silver. The contents of the flasks were filtered, and filtrate tested for sulphate with barium chloride. The residual coke was then boiled with aqua regia and potassic chlorate. The total sulphur by acid is the sum of the three products.

"Select Methods in Analysis"), who draws attention to the fact that boiling nitric acid gives results considerably below those obtained by fusion. He came to the conclusion that it was not that some of the sulphur was not oxidised, but that it was lost by volatilisation on evaporating to dryness. By adding a little nitre to the solution before evaporating to dryness to fix the sulphuric acid formed, he obtained results as accurate as those obtained by fusion. Table I. shows that Crossley's conclusion does not hold for all cokes, as by using different weights of coke and different amounts of acid, the same result can be obtained for the same coke, although that result is far below its real value. On fusing the residual coke after treating with acid, an amount of sulphur equal to that required to make up the amount equal to that obtained by fusion is obtained, thus showing that the acid has not oxidised all the sulphur existing in the coke.

NOTICES OF BOOKS.

Original Research. The Governing Principles of the Elements; explaining and supplementing Dr. Dalton's Doctrine of Definite, Reciprocal, and Multiple Proportions, and the Substitution, Hydrogen-replacement, and Compound Radical Theories of Modern Chemistry. By Herbert Masson. Part I. London: H. Masson, 11, Bedford Street, W.C.

The somewhat mysterious announcements which lately appeared in our advertising columns were intended to herald to the scientific world the *magnum opus* the first part of which is now before us. The key to the Universe, the grand *arcanum* which shall for ever disperse the clouds of ignorance from the fields of Science, is here offered us in imposing form and in language which rises in magniloquence until it even bursts into exceedingly blank verse.

The preface is much in the style of the advertisement, and must have given the author considerable pleasure. It points out that "Dr. Dalton, in enunciating his theories, could not explain the secret and hidden governing principles which *compel* atomic matter, when placed under the necessary conditions, to combine in definite proportions by weight, or in a certain ratio of multiple proportions." This task has been reserved, it appears, for Mr. Masson, and his preface concludes with the satisfactory announcement that "the chemist will instantly recognise the true explanation of the phenomena so familiar to him, and at once perceive that the problem of chemical combination is solved.

Fired with the hopes thus excited we turned to the body of the work, and read it again and again, each time with a more profound sense of bewilderment, until it seemed as a kind of scientific nightmare. For in spite of type of all sizes, and repeated assurances that everything was being explained, the style proved to be so obscure, the grammar so terrible, and the author's notions—when by chance we grasped them—so crude and foggy, that anything like real comprehension appeared impossible. If, therefore, we attempt to give some kind of sketch of the contents of the work, it is with the frank admission that we do not fully understand it.

The starting-point is the assumption—rather a cool one—that "all the separate atoms of the simple elements are condensations of hydrogen units which, in their aggregation, have left out of equilibrium with the rest of the atom either one, two, three, four, five, six, or seven constituent units, each of which are [*sic*] of the value of one free hydrogen unit." Of these constituent units some, which form the *nucleus*, stand in equilibrium in the centre; the others are placed unsymmetrically to the right and left. The number of units on the right is less than on the left, the deficiency indicating the quantivalence of the atom. Thus with sulphur and phosphorus the atoms are represented as follows:

$$S = {}^{4}_{4}\,18\,{}^{4}_{2}. \qquad P = {}^{4}_{4}\,18\,{}^{3}_{2}.$$

It is, of course, easy to manipulate the atomic weights in this way, and thereby to indicate the quantivalence of the elements. All depends on the quantity you leave as nucleus. Molecules are formed, first, by the addition of other atoms (called *subordinates*) or radicals to the right, or by their addition to the left of the atom, in which latter case the combining value of the right is assumed to be diminished in like proportion. When the number of units on the right is raised to equality with those on the left, the *ruling number*, which cannot be exceeded, is reached.

Armed with atomic formulæ such as these, so easily—and it appears to us so gratuitously—constructed, the author proceeds to employ them in the representation of inorganic and organic compounds. Elaborate tables of compounds are given in which many refinements of the general system are introduced, but into the details of these we cannot enter. We fail to see that the author really explains anything. We do not know what he means by equilibrium among the constituent units, or what is the "fundamental principle" of which he writes, and are consequently quite unable to endorse the remarkable passage with which his first section ends. We give it in Mr. Masson's own words—and grammar:—

"The reader, after going through the sulphur compounds, will know the *reason*, the *why*, these combinations are formed; will have seen the cause, and the sufficiency of that cause to produce the effects; and the single letter S will represent to his mind not only the atomic weight and the equivalence of the element, but also the governing principles which subjects its own subordinates, and rules its relations with other compounds."—P. 13.

The finest thing in the book, because the most amusing, is the poem entitled "Carbon in its Organic Relations." Carbon speaks first, exhorting the chemist to search, and boasting in language which is possibly pure carbonese of his triumphs in Nature:—

> "'Neath summer skies
> My nest lies hid amongst the flowers, where a
> Thousand beauteous forms and tints of colour
> Grace and adorn my floral fairy-home."

But the Chemist is promptly down upon him, and "shuts him up" with the following pithy stanzas, which almost make one sorry for the unfortunate element:—

> "Not thus shall be my search proud element;
> But I will take one of thy wondrous forms,
> One of thy grandest structures, and by the
> Potent agency of Heat I will command
> Thy subordinates to fly from thee.
>
> "What art thou now? Poor Element! Black as
> The shades of Night; the slightest touch will crush
> Thee into powder, a mass devoid of
> Colour, form, or beauty.—Disclose thyself."

After which terrible allusion to destructive distillation the poet returns quietly to symbols.

The Retrospect of Medicine, &c. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. lxxvii., January and June, 1878. London: Simpkin, Marshall, and Co.

There is but little to interest the chemist in the latest issue of Braithwaite's "Retrospect of Medicine," showing that even in this enlightened age the number of medical men that look upon chemistry as one of the most valuable handmaidens to the art of healing is still very small, although it must be acknowledged that they are slowly increasing. The extended use of amyl nitrite and iodoform, the introduction of thymol as a substitute for carbolic acid as an antiseptic in the Listerian system of treating wounds, and as a topical remedy in certain skin

diseases, and of chrysophanic acid in psoriasis are about the only items relating to chemical science occurring in the volume. This strange neglect of chemistry on the part of medical men will undoubtedly continue while the present cramming system remains in fashion.

The Transactions of the American Medical Association. Vol. xxviii. Philadelphia. 1877.

We should not have noticed this work at all if it did not fully confirm what we have already so repeatedly said touching the singular apathy with which the medical men of the present day seem to regard chemico-physiological studies. We had thought that in practical America at least—which has already endowed the world with so many valuable vegetable remedies—some one of her thousands of heavily diplomaed sons would have tried at least to have added one more chemical remedy to our very meagre list. Throughout the whole of the 700 pages of this report there is not the vaguest allusion to any such research, past, present, or future. Materia Medica, too, seems almost entirely neglected, the only notice of this branch of medical science being a few lines devoted to salicic and salicylic acid as remedies for rheumatism, and strychnia, woorara, and zanthium (*sic*) spinosum in rabies, and gelseminum in neuralgia.

It may interest some of our readers to know that the Association is using every possible effort to procure the passing of the Morrison Bill now before Congress, which will have the effect of abolishing the heavy prohibition duty on foreign quinine, thus entitling them to the thanks of their fever-stricken fellow-countrymen of the West, and to the gratitude of the manufacturers of that precious alkaloid in Europe.

Domestic Medicine and Hygiene. Being a Short Account of the More Common Diseases, their Causes and Treatment. Written in plain language, by William J. Russell, M.B. London: W. H. Everitt, 34, Bouverie Street. 1878.

Manuals of domestic medicine may be divided into two classes—those written by medical men, which are in most cases rendered unintelligible to the ordinary reader by the constant occurrence of scientific terms whose meaning is known only to the initiated; and those written by ordinary compilers, which are always more or less erroneous and very often dangerous. Dr. Russell's little manual steers clear of both these evils, and gives a clear and concise account of most of the diseases that affect the human subject, and the remedies to be applied, in plain straightforward language, which even the poorly educated will not fail to understand.

This little book, which literally teems with information in spite of its size, was primarily intended as a companion to the medicine-chest containing Thevenot's globules (of which a notice has already appeared in the Chemical News), but it may be used with equal advantage by those who have not the good fortune to be acquainted with these convenient medicaments.

The information conveyed is excellently arranged. The Introduction gives a short account of the nature and properties of different foods and drinks; the hygienic effects of exercise, bathing, sleep, clothing, &c.; and some very salutary warnings on the use of purgatives, so-called soothing medicines, and popular nostrums, as well as some useful hints about the evils of prescribing for one's friends.

The first part treats of general diseases, such as fevers, small-pox, measles, diphtheria, constitutional ailments, such as rheumatism, cancer, scurvy, dropsy, &c. The author then passes on to local diseases, such as water on the brain, sunstroke, paralysis, affections of the eye, ear, skin, heart, lungs, stomach, and so on. The third part, which begins at Chapter IX., gives an account of the diseases and management of children in a very sensible manner, while the next chapter is devoted to the last scene of all—second childhood. Chapter XI., treating of local injuries and emergencies, is much too short for a popular manual of the kind; for instance, nothing is said about the treatment of cuts and wounds which have become inflamed from neglect. The chapter on poisons and their effects is copious and precise; and the last chapter, on Materia Medica, deserves similar praise.

We are sorry to say that the Index is particularly meagre, barely four pages being given to the contents of over four hundred. This is a defect, however, which is to some extent compensated for by the admirable arrangement of the subject-matter.

Emigrants, travellers, and wanderers generally, Lady Bountifuls, and country clergymen will find Dr. Russell's little book an invaluable guide, more especially if they supply themselves with a small stock of Thevenot's globules.

Design and Work: a Mechanic's Journal for Workmen of all Trades. Vol. IV., Vol. I. New Series. London: G. Purkess. 1878.

In many respects this is an excellent journal, and is a very gratifying proof that the English workman is making steady progress in science. Primarily it is a technological journal, and treats of almost every known handicraft, from organ building to electro-plating and paper-collar making. The articles on technological subjects are numerous, and seem for the most part to be written by practical men, but some of them want editing most woefully. It is a singular fact that whenever a thoroughly practical man gets a pen into his hand he at once becomes the most unpractical of human beings, and instead of using the common everyday phraseology that he would use in instructing his apprentice, he bursts out into a torrent of what he imagines to be fine writing, and talks about the "functions of the carpenter," "the manipulation of timber," and other similar expressions. To such writers we would recommend an attentive study of the valuable articles called "The Mechanic in the Workshop," by "Practical Mechanic," who seems to be as much at home with his pen as he certainly is with his file and chipping chisel.

In addition to the articles on technological subjects we have a large amount of excellent information on the scientific discoveries of the day, the telephone, microphone, and phonograph of course receiving the lion's share of attention. There are also serial articles on chemistry and physics, but the less said about them the better. The intentions of the authors are no doubt excellent, and as a rule are fairly carried out, but the workman wants to know why iron rusts red in water and black in the fire; why one oil will dry and another will not; why he "kills" his spirits of salt with zinc before using it as a solder, and a hundred other simple items of information, without having his brain addled with mathematical formulæ, thick and thin symbols, bonds, and graphic formulæ.

The Notes and Queries department, with their corresponding answers, form a valuable feature; but would not its usefulness be greatly increased if some kind of supervision were exercised over certain long-winded writers? The journal is copiously illustrated with woodcuts, but many of them are far from being worthy of the text they illustrate.

These critical remarks are made in the most friendly spirit, and we heartily congratulate our fellow editor in having reached his fourth volume.

Seaside Water: an Examination into the Character of the Water-Supply at the Watering Places of England and Wales. By G. W. Wigner, F.C.S. London: Kent and Co.

Mrs. Grundy has decreed that all who are able to go out of town in the summer shall make their way to some

seaside locality. Inland places, such as Keswick, Ambleside, Dolgelly, Castleton, Lyndhurst, or Edwinstowe—however teeming with objects of interest and beauty—are neglected, while such dreariness as Blackpool and Southport, Harwich and Clacton—where there is not the remotest approximation to pleasant scenery, count their visitors by thousands. Such being the case, Mr. Wigner has not done ill to investigate whether those who leave their homes in the real or pretended pursuit of health may not run the risk of imbibing the germs of disease. We might think that as soon as a town or village sets up for a watering place its local authorities would make it one of their first duties to secure proper sanitary arrangements. The water-supply of a health resort ought to be, like Cæsar's wife, above suspicion. But the result of Mr. Wigner's investigations shows that such expectations are not as yet fulfilled. It is sad to think of invalids having to drink water of "a dirty yellow-green" colour, in which "the microscope shows not only living organisms of various kinds in abundance, but pieces of skin and muscular fibre, and an excessive proportion of organic remains of all kinds." We read of other samples "full of bacteria," having "an unquestionable smell and taste of sulphuretted hydrogen and excreta," giving off when warmed "a distinct smell of urine," &c. It is, indeed, perfectly true that in many rural districts of England—we might instance central Suffolk—waters fully as bad as any that figure in Mr. Wigner's report form the sole available supply of a population who are far from showing any excessive mortality. But there is an important distinction to which Mr. Wigner refers, but which deserves to be brought into more decided prominence. The population of such villages has been habituated for generations to the use of waters which have gradually become more and more polluted. Those persons easily affected by such influences have been killed off, and thus by a process of natural selection a race has been formed who can drink diluted sewage with impunity. But in a watering place the conditions are totally different. We have here a population consisting largely of strangers perhaps, accustomed to drink the comparatively pure waters supplied to London, Manchester, Leeds, or Glasgow. Such persons, suddenly compelled to drink polluted waters, can scarcely fail to be injuriously affected.

We trust that in all such places the local authorities will take to heart the lessons conveyed in Mr. Wigner's pamphlet, and bestir themselves at once to procure a satisfactory supply of the "first necessary of life."

Holmes's Botanical Note-Book: a Practical Guide to a Knowledge of Botany. By E. M. Holmes, F.L.S., Curator of the Museum of the Pharmaceutical Society of Great Britain; late lecturer on Botany at Westminster Hospital. London: Christey and Co. 1878.

This is a handy volume for the use of medical and pharmaceutical students who wish to gain something more than a mere book knowledge of botany. The bulk of the volume consists of sixty schedules containing the principal characters of each plant to be filled up by the student from actual observation, thus ensuring an intimate knowledge of each specimen. It also contains a variety of information with respect to the collection and examination of plants, and two charts, one showing the natural orders of flowering plants in general, the characters of all the orders indigenous to Britain. There is also a list of the plants most easily obtainable during each month of the year, so that the student may keep himself busy from January to December. As an efficient antidote to the cramming system as applied to botany we cordially recommend Mr. Holmes's little work. The student who has filled up the sixty schedules of this book from actual observation will know ten times as much botany as if he had studied the whole of the numerous manuals on that subject and had learned their definitions and descriptions by heart.

Zeitschrift für das Chemische Gross gewerbe. Kurzer Bericht über die Fortschritte der Chemischen Grossindustrie. In Vierteljahres heften.* II. Jahrgang. By Jul. Post. Berlin: R. Oppenheim.

We have here a most useful compendium of discoveries, inventions, and improvements connected with chemical manufactures, compiled with that patience and thoroughness which are so characteristic of German science. The subjects treated of are trade politics, trade hygiene, factory legislation, &c.; literature, plant, and machinery relating to the chemical arts; purification of water; fuel, and the production of heat; utilisation of wood-tar; paraffin and petroleum; coal-gas, utilisation of gas-liquor; sulphur, acids, alkalies, salts of alumina, chromates, and borates; chlorine and chloride of lime; oils and fats; starch and sugar; fermentation and alcohol; wine, beer, and vinegar; colours and dyeing; tanning and glue; manure manufacture; explosives; glass, earthenware; lime, cement, and gypsum; metallurgy; bread, and the preservation of articles of food; the minor chemical arts; and, lastly, chemical patents. In all these various departments the editor enjoys the assistance of men practically acquainted with their respective subjects. It may throw some light upon the intelligent zeal with which the chemical arts are now cultivated in Germany if we mention that one of these sub-editors is described as representing the "Experimental Station of the United Spirit Trade of Germany." Another holds a similar position in the "Scientific Experimental Station for Brewery." The leather trade and the manure manufacturers have also organised similar "stations."

The journal before us must be of the highest value to chemical technologists, and we wish it ample success.

CORRESPONDENCE.

COLOURED COMPOUNDS OBTAINED FROM BRUCINE.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxxviii., p. 35, I observe an extract from an article by R. Röhre, entitled "Behaviour of the Products Obtained by Treating Brucine with Nitric Acid and Reducing Agents."

In the Chemical News, vol. xxxvii., p. 98, I described some of the properties and a simple method of preparing the violet crystalline compound referred to in the above article. I believe the substance had not been obtained in a separate form by any one else before.—I am, &c.,

David Lindo.

STATEMENT OF THE RESULTS OF ANALYSIS OF COMMERCIAL PHOSPHATES.

To the Editor of the Chemical News.

Sir,—May I be allowed to say a few words on Mr. Jamieson's letter in the Chemical News, vol. xxxviii., p. 130, in which he finds exception to an assertion I made to the effect that the acetate of ammonia precipitate in phosphatic materials is not a definite chemical compound?

Mr. Jamieson's letter, instead of refuting my statement, confirms it in a very satisfactory manner. He says that he finds the "phosphoric anhydride" in the acetate of ammonia precipitates "to be almost identical with the quantity found by reckoning as phosphate of iron." Now, as many of the substances in which phosphoric acid has to be determined contain 3 or 4 per cent of alumina, we are forced to the rather unpleasant conclusion that these precipitates do not consist wholly of the ortho-phosphates

* Journal for the Heavy Chemical Trades. Brief Report on the Progress of the Chemical Arts. In quarterly issues.

of iron and alumina, or that Mr. Jamieson's determinations are wrong; unless, indeed, phosphate of iron and phosphate of alumina have the same equivalents.

Neither can I believe that it is the intention of the Committee that the phosphoric acid should be directly determined in these precipitates, for surely no process requiring more than double the amount of necessary work would commend itself to chemists.—I am, &c.,

ALFRED SMETHAM.

1, Park Lane, Stoke Newington, N.,
September 7, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 8, August 19, 1878.

On a New Mineral named Thaumasite.—M. Nordenskiold.—The composition of this mineral is given as $CaO,SiO_2+CaO,SO_3+CaO,CO_2+14HO$.

Spectrometric Study of Certain Sources of Light.—A. Crova.—The spectra compared are the solar, that of the electric light, of the Drummond light, and of a moderator lamp. The intensity of the red being the same in the four, the fading off towards the violet varies with each source, according to a certain function of temperature.

A Wandering Electric Spark.—G. Planté.—The condensers of mica which enter into the construction of the rheostatic machine are sometimes perforated when too slender under the action of a current of 800 secondary couples, just as is the glass of an overcharged Leyden jar. This accident enabled the author to observe a very curious fact, which consists in a slow and progressive movement of the spark, which the author shows in an illustration.

On a Telephone Transmitting Sounds to a Distance.—M. Righi.—The receiver of this arrangement is a Bell's telephone, only that the plate of iron is fixed on a membrane of parchment paper, stretched at the bottom of a funnel, and the magnet is thicker than usual. The transmitter is composed of a plate of wood, or of metal, or of an extended membrane, in the midst of which is fixed a piece of metal whose lower surface is plane. This piece rests upon a conducting powder placed in a metallic cube, supported by an elastic blade pressed by a screw. The powder may be formed of silver, copper, iron, charcoal, graphite, or, preferably, of a mixture of one of these latter substances with silver.

Improvement in the Peroxide of Manganese and Sal-ammoniac Battery.—M. Leclanché.—The author uses masses agglomerated by the hydraulic press in the form of places adhering to a surface of gas-coke of about half a square decimetre.

Dissociation of Metallic Sulphides.—MM. de Clermont and Frommel.—The experiments of the authors relate to the sulphides of arsenic. They consider that the pentasulphide either does not exist or that it is so unstable as not to resist even the feeblest agents.

Value of Magnesia as an Antidote to Arsenious Acid.—MM. de Clermont and Frommel.—The authors show that if arsenious acid passes into the state of trisulphide, either in the stomach or in the intestines, the administration of magnesia renders this sulphide soluble and assimilable. This transformation of arsenious acid is not a mere hypothesis, but has actually been observed.

Two Deposits of Phosphate of Lime in the Vosges.—P. Guyot.—Specimens from Damblain contain 76·99 tribasic phosphate; those from Blevaincourt 77·74 per cent.

New Meteoric Mineral, Daubreelite.—Lawrence Smith.—The composition of this mineral is:—

Sulphur	42·69
Chrome	35·91
Iron	20·10
	98·70

It occurs very frequently in meteorites.

No. 9, August 26, 1878.

Vibratory Forms of Solids and Liquids.—M. C. Decharme.—The author concludes the following law. Upon circular plates the breadths of the striæ are inversely proportional to the square roots of the numbers of vibrations of the corresponding sounds.

On Pelletierin, an Alkaloid from the Bark of the Pomegranate.—C. Tanret.—This compound is colourless, but becomes coloured on exposure to the air. Its sp. gr. at 21° = 0·985. It is very soluble, and dissolves in water with contraction. It is dextrorotatory. Its aqueous solution has a rotatory power of $[a]j=+8°$. With sulphuric acid and potassium bichromate it gives a green as intense as does alcohol under the like conditions. Its composition is expressed by the formula $C_{16}H_{13}NO_2$. It is the taenicide principle of pomegranate bark.

Researches on Strychnin.—MM. H. Gal and A. Etard.—By the action of hydrated baryta upon strychnin the authors have obtained two new bases, which they name dihydrostrychnin, $C_{42}H_{26}N_2O_8$, and trihydrostrychnin, $C_{48}H_{28}N_2O_{10}$.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin. No. 9, 1878.

Preparation of Quinon.—R. Nietzki.—If a solution of hydroquinon is mixed with excess of potassium bichromate and sulphuric acid in the cold, on agitating the mixture with ether and allowing it to evaporate quinon is obtained almost in the theoretical proportion.

Rosolic Acid and Rosanilin.—H. Caro and C. Graebe.—The author retains the name rosolic acid exclusively for the acid $C_{20}H_{16}O_3$, which is obtained from rosanilin, $C_{20}H_{19}N_3$. Aurin is the compound of phenol and para-rosanilin. Aurin and para-rosanilin agree in this property, that they are precipitated by hydrochloric acid from a hot alkaline solution in very characteristic needles, fine as hairs, which dissolve without melting in the dilute boiling liquid, and on cooling appear as a heap of felted needles of a reddish yellow colour, and a lustre resembling chromic acid. Under the same circumstances rosolic acid forms confused resinous drops of a metallic green, which congeal slowly and never form needles. The authors are of opinion that rosolic acid, rosanilin, and their accompanying leuco-compounds are derivatives of one and the same hydrocarbon. Rosanilin and rosolic acid are derivatives from a tolyl-diphenyl-methan; aurin and para-rosanilin from triphenyl-methan.

Determination of Hydrogen in Gas Analysis.—H. Bunte.—This paper cannot be intelligibly abstracted without the accompanying figure.

Aromatic Hydantoins.—P. Schwebel.—(Second communication.) An examination of the behaviour of urea with tolyl-glycocoll.

Action of Bromine Water and Nitrous Acid upon Phenyl-glycocoll.—P. Schwebel.—The author has obtained and examined tribromo-phenyl-glycocoll and nitroso-phenyl-glycocoll.

Bulletin de la Societe Chimique de Paris, Tome 30, No. 3, Aug. 5, 1878.

New Method of Preparing Allyl Bromide.—M. H. Grossheints.—The author adds to potassium bromide

sulphuric acid, diluted with an equal volume of water, and heats the mixture in a simple distillatory apparatus. When hydrobromic acid begins to escape, allylic alcohol is allowed to fall in drop by drop, and the bromide distils along with watery vapour.

On Diehic Acid.—M. Maumené.—Already noticed.

Œnocyanin.—M. E. Maumené.—The author denies that the name œnocyanin has been given by Mulder to a "blue matter not yet analysed." M. Gautier appears to commit a second error in ascribing to the blue matter which the author has named œnocyanin the composition given in the *Comptes Rendus*. It contains no iron when obtained under the conditions indicated.

On Ethylen Cyanide.—Nilan Nevolé and J. Tcherniak.—The authors have greatly facilitated the preparation of this salt, and obtain it perfectly pure by a process which they describe. They have not found it possible to obtain appreciable quantities of normal butylen-diamin by Fairley's method, the reduction of ethylen cyanide by tin and hydrochloric acid.

Mono-chloro-ethyl-acetamid.—T. H. Norton and J. Tcherniak. — This compound, when recently prepared, forms a very mobile liquid, neutral to paper, and possessing an irritating and slightly camphory odour. It is soluble in all proportions in water, alcohol, and ether. Carbonate of potassa separates it from its aqueous solution. It is not distillable without decomposition.

Ethoxy-aceto-nitrile.—T. H. Norton and J. Tcherniak.—Ethoxy-aceto-nitrile, the first fatty oxythylated nitrile is formed by the dehydrating action of phosphoric anhydride upon ethyl-glycolamide.

A New Manner of Forming Ethylic Glycolate.—T. H. Norton and J. Tcherniak.—Glycolide is enclosed in sealed tubes with its equivalent quantity of absolute alcohol.

Certain Compounds Analogous to Chrome Iron.—M. J. Risler.—The author has formed and examined the manganites of calcium, barium, strontium, zinc, and lead.

Production of the Ultramarines of Different Metals.—MM. Forcrand and Ballin.—The authors have studied the formation of the yellow ultramarine of silver, the regeneration of blue ultramarine from this yellow form, and the transformation of yellow ultramarine into the ultramarines of potassium, barium, zinc, and magnesium. Their yellow ultramarine is not a mixture, but a homogeneous compound, showing under the microscope no grey or black particles of metallic silver. This yellow ultramarine, if heated with pure potassium chloride, yields a bluish-green potash ultramarine; with barium chloride, a yellowish brown potassic ultramarine; with zinc chloride, a violet zinc ultramarine.

Presence of Arsenic in Sulphuric Acid made from Pyrites, and in Certain Salts of Soda Prepared with such Acid.—M. E. Hjelt.—In Spanish pyrites the author, using A. Smith's method, finds 0·91 per cent of arsenic; in Westphalian 0·30, and in Norwegian mere traces. In chamber acid he finds 0·202 of arsenic; in the acid from Glover's tower 0·331, and in that from Gay-Lussac's condenser 0·334. The bulk of this arsenic is present as arsenious acid. In the last chamber the acid contains merely 0·019 per cent of arsenic. The mud deposited in Glover's towers consists chiefly of arsenious acid.

Biedermann's Central-blatt,
Heft 5.

Proportion of Ozone in the Air in the Libyan Desert.—P. Ascherson.—The author has made above 100 observations in the Nile valley, in the Oasis of Bauiti, and in the intervening desert. The proportion of ozone was found uniformly larger by night than by day. The lowest results were obtained in calms, and the highest in time of northerly winds, and especially in dewy nights. The author concludes that the condensation of watery vapour is as decidedly a source of ozone as is evaporation.

Influence of the Soil and of Forests upon Climate.—L. Fautrat.—From the *Comptes Rendus*.

Carbonic Acid in Sea-water.—J. Buchanan.—The quantity of carbonic acid in sea-water is much larger than that which an equal volume of distilled water is able to retain under similar circumstances.

On Changes of the Soil in Volume.—Prof. F. Haberlandt.—The extreme changes of volume which soils undergo according to their dry and moist condition, range from 0 to 30 per cent. They are measurable only in soils of a solid texture. Humus has the greatest influence upon the shrinking of a soils during its drying.

Experiments on Nitrogenous Manures.—Prof. R. Heinrich.—Of all the nitrogenised manures nitre applied in spring gave the best results both in corn and straw. Nitrogen in blood-dust, horn-dust, and fish-guano are about equal in value for winter corn and on a sandy soil. Sulphate of ammonia, under these circumstances, has no higher value. Meat-dust, rich in fat, had no action. Hence other animal manures, *e.g.*, fish-guano, should be freed from oil before use.

Influence of Atmospheric Moisture on the Development of Plants.—Dr. P. Sorauer.—Moist air produces a greater length of stems and roots.

Chemical Studies on Wine.—T. Peneau.—According to the author's analytical results, the acidity of wines is not exclusively due to tartar, but depends in great part on volatile acids, especially acetic acid. The glycerine bears no fixed proportion to the alcohol, but, like the succinic acid, varies according to the manner in which the fermentation is conducted.

Preservation of Fruit.—A. dal Piaz recommends to lay the fruit in a solution of sugar, mixed with salicylic acid. The proportions are 100—500 grms. sugar, 2½ to 3 grms. salicylic acid to 1 litre water. Cherries, raspberries pears, grapes, &c., have been preserved in this manner for a year without losing their natural aroma.

Chemiker Zeitung.
No. 33, August 15, 1878.

The Medical Faculty of the University of Tubingen publish a letter which they have received from a diploma-broker in London. He substantially asks the faculty on what terms they will pass his candidates as M.D., offering to remit the customary fee, "and something more." We regret to find that the writer of the letter appears to be an Englishman.

No. 34, August 22, 1878.

At Brunswick several children have become ill in consequence of eating ginger-bread.

A serious explosion took place on the 15th inst., at the Badische Aniline and Soda Works, at Mannheim. Four men were seriously injured.

The first premium for a model of the proposed monument to Liebig has been awarded to the sculptor, Wagmüller.

Behaviour of Magnesian Salts with Lime Salts at various Temperatures.—Bohlig calls attention to the fact that at temperatures up to 100° carbonate of magnesium and gypsum are transformed into carbonate of lime and sulphate of magnesia. On the other hand, at temperatures above 120°—as steam boilers—carbonate of lime and sulphate of magnesia yield carbonate of magnesia and sulphate of lime. If the pressure in the boiler exceeds 3 atmospheres, the magnesia is found in the sediment not as carbonate, but as oxide. It follows from Bohlig's experiments that the old statement of the text-books, that carbonate of magnesia is deposited on boiling

natural water, is incorrect. If gypsum is present in sufficient quantity, and the temperature has not risen above 100°, the precipitate must be free from carbonate of magnesia. The method hitherto followed of inferring the quantity of bicarbonate of lime present in the water from the lime found by prolonged ebullition of the precipitate, must lead to exaggerated results.—*Zeits. Anal. Chemie*, xvii., 301.)

Detection of Small Quantities of Iodine in Sea-Water, &c.—The liquid to be tested is placed in a test-tube along with carbon disulphide, and a few drops of dilute sulphuric acid. Hereupon the vapour of red fuming nitric acid is allowed to fall for a moment into the tube. After strong agitation, the sulphide of carbon is coloured rose colour if the slightest trace of iodine is present.—(*Zeitsch. Anal. Chemie*, xvii., 305.)

Detection of Free Tartaric Acid in Wine.—Claus evaporates the wine to the consistence of a group, shakes up with ether (in which, contrary to the statement of the text-books, tartaric acid is freely soluble), and dissolves the crystalline residue left on the evaporation of the ether. If an alcoholic solution of acetate of potassa is added to the liquid, crystals of tartar will be formed, if free tartaric acid must have been present in the wine, which, if in any important quantity is a suspicious feature. —(*Zeitsch. Anal. Chemie*, xvii., 314.)

New Determination of Glucose and of Mercury.—Hager mixes the aqueous solution of glucose, neutral or acid, with a mercuric acetate dissolved in a solution of sodic chloride in excess, and heats for an hour or upwards on the water-bath. A precipitate of mercurous chloride is formed, which is washed successively with very dilute hydrochloric acid, water, and alcohol, dried in the water-bath and weighed. The weight of the precipitate divided by 5·88 gives the quantity of the glucose, and divided by 6·19 the quantity of the saccharose which has been converted by acids into glucose. The reagent is prepared by grinding up 30 grms. red mercuric oxide with 30 grms. sodic acetate, and covering with 25 grms. concentrated acetic acid in a flask. Hereupon 50 grms. sodic chloride are added, and the whole made up to 1 litre. To 1 grm. glucose 200 c.c. of the liquid are required.—(*Zeitsch. Anal. Chem.* xvii., 380.)

Oxalic Acid in Toxicology.—Van Melckebebe shows that in the processes used for the destruction of organic matter in toxicological investigations, oxalic acid is always formed by the oxidation of the hydrates of carbon, which are always present. Hence it may be erroneously concluded that the acid was administered as a poison during the life of the subject.—(*Pharm. Centralhalle*, xix., 273.)

No. 35, August 29, 1878.

An article on chemical theories concludes with the following passage:—"Thus the fabric of the structural theory, scarcely raised to its top stone, begins to totter on its foundation, confirming the saying of Mephistopheles—"Grey, worthy friend, is every theory." Many chemists of the present day give simply empirical formulæ and reject every theoretical conception. Whether a new system will be developed, whether such will incline to the unitary or the dualistic view, or whether it will be found practicable to shore up the structure of the structural theory and supply it anew with firm foundations, the future must decide."

Reimann's Färber Zeitung,
No. 31, 1878.

Alizarin Carmine, a New Tinctorial Substance.—This compound, recently introduced into the market as a dye for woollens, is the sodium salt of a sulpho-acid of alizarin. With the ordinary mordants it gives a variety of brown, chocolate, orange, red, and scarlet shades. The latter, though inferior in brightness to cochineal and eosin scarlets, are absolutely fast as against air and light, and are injured neither by soap-lyes nor by perspiration. The new colour will therefore be well adapted for carpets, hangings, military uniforms, &c.

No. 32, 1878.

The Valuation of Insoluble Colours.—The method recommended is the well-known process of ascertaining how much of a white powder—zinc-white is the one here selected—to let down a pure normal colour to the shade of the sample under examination.

Malachite green has exactly half the solubility of crystallised methyl green. It is dissolved in boiling-water.

The condition of the Alsatian calico-printing establishments is represented as deplorable, several of the leading houses being shut up. An import duty on English printed goods is recommended as a remedy.

No. 33, 1878.

This issue contains nothing of general interest.

Revue Universelle des Mines, de la Metallurgie, &c.,
Tome 3, No. 2, March and April, 1878.

This issue contains no chemical matter beyond certain extracts from the *Comptes Rendus*.

Tome 3, No. 3, May and June, 1878.

Note on the Relation between the Origin and the Geometrical (?) Characters of the Guano Deposits.—E. Detienne.—The author, whilst admitting the animal origin of the Peruvian guano beds, remarks that uncertainty prevails with regard to the elevated position which some of them occupy. Thus at Pabellon de Pica guano is found at the altitude of 160 metres, a height incompatible with what is known concerning the habits of sea-fowl, and especially of seals. The author accounts for these phenomena by a progressive elevation of the coasts, so that the oldest deposits are the most elevated. Other facts corroborate this view.

On the Graduation of Burettes.—M. L. L. de Koninck.—The author shows that there exists a notable discrepancy in the graduation of burettes, even if procured from the most eminent makers. He mentions two burettes which, if used for the determination of ferric oxide by the permanganate process, would show a discrepancy of 1·70 per cent.

Archives Neerlandaises.
Tome xiii., 1me Livraison.

Considerations on the Theory of Capillary Phenomena.—P. M. Heringa.—An extensive mathematical paper, not adapted for abstraction.

Fourth Memoir on the Piscifauna of New Guinea.—M. P. Bleeker.—The author has identified and described 269 species of fishes from New Guinea.

Certain Cases of Movement in a Non-Compressible Fluid.—G. J. Michaelis.—Incapable of abstraction.

The Numerical Determination of the Power of Distinguishing Colours.—F. C. Donders.—The author proposes to obtain a numerical determination by indicating the limit at which a colour or shade of colour can still be recognised with certainty. This limit may be sought, *a* in the luminous intensity, *b* in the saturation, and *c* in the visual angle.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 17, August 22, 1878.

Liquid Rings.—M. Escriche.—If from a small height we let fall slowly into a dilute solution a few drops of another solution capable of forming a precipitate with the

former, we see rings formed which descend to the bottom of the vessel, rolling over upon themselves just as do the rings produced by the liberation of phosphorus trihydride.

No. 18, August 20, 1878.

Darkness of Caverns.—The fact that the light of torches does not diffuse itself in a cavern is ascribed to the presence of a mouldiness which covers their roofs and sides, and absorbs all those floating particles of dust which would otherwise act as reflectors.

MISCELLANEOUS.

Messrs. Johnson and Matthey's Exhibit at the Paris Exhibition.—In our issue of July 26 we referred to the excellence of the exhibit of this eminent firm at the Paris Exhibition. We have now the pleasure of stating that two grand prizes have been awarded to them, one in Class 43 and another in Class 53. The *Grand Prix* is the highest class of recompense; the *Grand Diplôme d'Honneur* is only given to a public body or Government for a collected exhibition, where a *Grand Prix* cannot be given.

South London School of Pharmacy.—This institution was opened for the tenth session on Tuesday, the 17th September, when a full attendance of new and old students took place. The annual report was read by Mr. Baxter (the Secretary), and an address to the students was delivered by Mr. Joseph Ince. The chair was occupied by the Rev. S. Bache Harris, Vicar of the Parish, who was supported by a number of local magnates and gentlemen interested in the school.

TO CORRESPONDENTS.

H. G. R.—It has not been done except by freezing.

R. Baybutt.—Consult Crookes's "Dyeing and Calico Printing."

N. M.—We are not aware that a second paper on Fremy's researches on Hydraulic Cements has yet been published.

Hugh Justence.—Reimann's "Aniline and its Derivatives," or Crookes's "Dyeing and Calico Printing." Both works are published by Longmans and Co.

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St. Mary's Hospital Medical School, Paddington, W.—Opening of WINTER SESSION, October 1st, 1878. Introductory Address by Dr. Farquharson.

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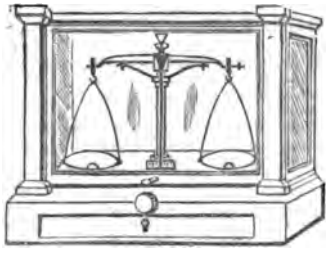

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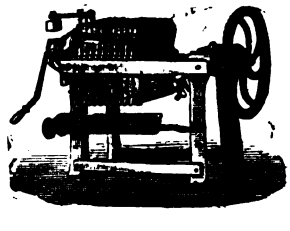

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 983.

ON THE ESTIMATION OF IRON AS FERRIC OXIDE.

By SERGIUS KERN, M.E., St. Petersburg.

THE author thinks it possible that several chemists use nearly the same method as is here described for the collection of the hydrated ferric oxide, and only gives notice of the method used by himself, as it has been remarked that in certain laboratories this flocky precipitate is collected on paper filters—a very tiresome operation.

In order to collect this precipitate a thin platinum funnel is used. The tube of the funnel is closed by asbestos-wool, previously ignited and weighed. The solution is next filtered, the precipitate washed. The funnel is then placed on a sand-bath, and when the precipitate is dry the bottom part of the funnel-tube is closed by means of a platinum stopper, and the whole is next ignited and weighed.

Knowing the weight of the asbestos and of the funnel, the weight of the ferric oxide may be calculated.

In this way the weight of many flocky precipitates in a dry state may be estimated in a quick and convenient manner.

ANALYSIS OF COMMERCIAL NITRATE OF IRON.

By W. E. BLYTHE.

No drug supplied to dyers seems to be of a more variable nature than the nitrate of iron. A sample recently purchased proved to be of the following composition;—

Fe_2O_3	18·12
SO_3	18·61
H_2O	63·26
FeO	trace
	99·99

Sp. gr. 1·41 = 82° Tw.

This sample, on dilution, deposited a basic oxide of iron, and contained (as shown above) not a trace of nitric acid.

It is hardly necessary to point out the difficulties that the use of this salt of iron might occasion a dyer who imagines he is using the nitrate. I have on several occasions seen persulphate of iron bought and paid for as nitrate.

VERIFICATION OF GRADUATED GLASS VESSELS AND AREOMETERS FROM 4° TO 45° C.*

By P. CASAMAJOR.

THE graduated glass vessels used in laboratories are generally divided into cubic centimetres, and the volumes designated are supposed to be correct at a certain temperature, taken as a normal, which is generally 15° C.

I propose now to give a table (No. 2) for the verification of these graduations at all degrees of temperature, from 4° to 45° C., in which will be found, for every degree, the weight of distilled water which will occupy a space which at 15° C. is equal to 100 c.c.

* Read before the American Chemical Society, July 11, 1878.

Afterwards I will consider the verifications of the graduations of areometers.

It is needless to add that the methods used for the verification can be easily applied to the graduation of measuring vessels and of areometers.

Let us suppose that we have a graduated flask, capable of holding 100 c.c. of water at 15° C., when filled up to a line etched on its neck, and that we wish to know if this graduation is correct. To ascertain this, we may fill up the flask with distilled water, at the temperature of 15° C., up to the line on its neck, and find whether the weight of the water is the proper weight. This leads us to inquire: What is the weight of distilled water which, at 15° C., will occupy exactly 100 cubic centimetres?

For the solution of this question, we have to make use of Table No. 1, which has already been published twice in our *Proceedings*,* but which must be given again in this place, as it is to be the base of all our calculations. In this table, as here given, the temperatures range from 4° to 45° C., while, as previously published, the lowest temperature was 5°.

In the first column of this table are the temperatures for every degree from 4° to 45° C. Opposite to these, in the second column, are to be found for every degree numbers representing the absolute expansion of 1 c.c. of water, starting from 15° C. as a normal. For the degrees below 15° the numbers in this column represent absolute contractions, and are to be subtracted. We may see, in the second column, that if we take 1 c.c. of water and heat it to 16°, it will become 1·000173 c.c.; if heated to 25° it will become 1·002179 c.c., &c. If, instead of heating, the temperature is lowered from 15° to 14°, 1 c.c. of water will become 1 − 0·000150 = 0·999850 c.c.; if cooled to 7° it will become 1 − 0·000820 = 0·999180 c.c., &c.

For the methods used in obtaining these numbers I must refer you to the *Proceedings* of this Society, vol. i., First Part, p. 193.†

TABLE No. I.

Total Expansions from 15° C.

Degs. C.	Absolute Expansion.	Relative Expansion.	Degs. C.	Absolute Expansion.	Relative Expansion.
4	0·000887	0·000600	25	0·002179	0·001919
5	0·000878	0·000612	26	0·002445	0·002159
6	0·000856	0·000622	27	0·002717	0·002405
7	0·000820	0·000612	28	0·002995	0·002657
8	0·000772	0·000590	29	0·003279	0·002913
9	0·000706	0·000550	30	0·003569	0·003179
10	0·000622	0·000492	31	0·003869	0·003453
11	0·000524	0·000420	32	0·004181	0·003739
12	0·000412	0·000334	33	0·004503	0·004035
13	0·000288	0·000236	34	0·004836	0·004342
14	0·000150	0·000124	35	0·005180	0·004660
15	normal	normal	36	0·005533	0·004987
16	0·000173	0·000147	37	0·005895	0·005323
17	0·000357	0·000305	38	0·006265	0·005667
18	0·000551	0·000473	39	0·006644	0·006040
19	0·000756	0·000652	40	0·007032	0·006382
20	0·000971	0·000841	41	0·007428	0·006752
21	0·001119	0·001039	42	0·007832	0·007130
22	0·001428	0·001246	43	0·008244	0·007516
23	0·001670	0·001462	44	0·008664	0·007910
24	0·001920	0·001686	45	0·009092	0·008312

The numbers of the third column represent the total *relative* expansions of 1 c.c. of water, starting from 15° C. as a normal. They were obtained by subtracting the number 0·000026, the coefficient of expansion of glass for 1° C. as many times, from the quantities in the second column, as there are units between the corresponding number of degrees and 15° C. The numbers in this third

* *Proceedings of the American Chemical Society*, vol. i., First Part, p. 193; Part Second, p. 20. Also see *American Chemist* for January, 1877, p. 251; CHEMICAL NEWS, vol. xxxv., p. 161; and *Moniteur Scientifique*, vol. vii., 3rd series, August, 1877, p. 862.

† Also *American Chemist, loc. cit.*; CHEMICAL NEWS, vol. xxxv., p. 161; and *Moniteur Scientifique* for March, 1877, p. 237.

column represent the apparent expansion of water in glass vessels.

If we wish to know the weight, in grammes, of 100 c.c. of distilled water at 15° C. we must refer to the definition of the gramme, which is: *the weight of 1 c.c. of distilled water at 4° C., taken in vacuo.*

By referring to the second column of Table No. 1, we may see that if we take 1 c.c. of water at 15° C., and lower the temperature to 4°, the cubic centimetre of water becomes $1-0.000887=0.999113$ c.c., which will weigh in vacuo 0·999113 grammes; therefore, the weight of 100 c.c. of distilled water at 15° C. and *in vacuo* is 99·9113 grms. To make this result of practical value, we must proceed to eliminate the two conditions of weighing *in vacuo* and at the temperature of 15°.

It is no easy matter to keep liquids for any length of time at a temperature different from that of the room in which we operate, and, when the temperature of the liquid is much lower than that of the room, condensation of moisture takes place on the surface of the vessel which holds the liquid, which circumstance interferes with accurate weighing.

As the most favourable condition is that the temperature of the liquid be the same as that of the room, I give, in the second column of Table No. 2, the quantity of distilled water to be weighed *in vacuo* at every degree from 4° to 45° C., so that the volume shall be that which in a glass vessel at 15° is equal to 100 c.c. We will afterwards eliminate the condition of weighing *in vacuo*.

If we had a flask made of a material which would not expand by the action of heat, and this flask had a volume of 100 c.c., we could calculate, from the second column of Table No. 1, for every degree of temperature above and below 15°, the weight of water which is equivalent to 99·9113 grms. at 15°, or, in other words, the weight of water which occupy 100 c.c. For instance, the weight at 16° would be—

$$99.9113 \times \frac{1}{1.000173},$$

and so on for every temperature above 15°. For 14° we would find—

$$\frac{99.9113}{1-0.000150},$$

and so on for every temperature below 15°.

TABLE No. II.

Weight, in Grammes, of Distilled Water, occupying a Volume, in a Glass Vessel, equal to 100 c.c. at 15° C.

Degrees Centigrade.	Weight of Distilled Water in vacuo.	Weight of Distilled Water at Pressure =760 m.m. of Mercury.	Degrees Centigrade.	Weight of Distilled Water in vacuo.	Weight of Distilled Water at Pressure =760 m.m. of Mercury.
4	99·9712	99·8595	25	99·7200	99·6163
5	99·9723	99·8610	26	99·6960	99·5927
6	99·9735	99·8626	27	99·6716	99·5686
7	99·9723	99·8618	28	99·6465	99·5439
8	99·9702	99·8601	29	99·6211	99·5189
9	99·9662	99·8565	30	99·5945	99·4926
10	99·9604	99·8512	31	99·5674	99·4658
11	99·9532	99·8444	32	99·5390	99·4377
12	99·9446	99·8362	33	99·5097	99·4087
13	99·9348	99·8268	34	99·4793	99·3787
14	99·9237	99·8161	35	99·4479	99·3476
15	99·9113	99·8041	36	99·4155	99·3155
16	99·8965	99·7896	37	99·3723	99·2726
17	99·8818	99·7753	38	99·3482	99·2488
18	99·8640	99·7578	39	99·3114	99·2124
19	99·8462	99·7404	40	99·2777	99·1790
20	99·8273	99·7218	41	99·2412	99·1428
21	99·8075	99·7024	42	99·2040	99·1060
22	99·7869	99·6821	43	99·1660	99·0682
23	99·7654	99·6610	44	99·1272	99·0298
24	99·7431	99·6390	45	99·0877	98·9906

As, however, we have to deal with a glass flask whose volume varies with the temperature we must use the third column of Table No. 1, the numbers of which were obtained, as we have already said, by subtracting from the corresponding numbers in the second column the number 0·000026, the coefficient of expansion of glass as many times as there are units in the difference between the number expressing the degree of temperature and 15° C.

If we have a glass vessel holding 1 cubic centimetre of water at 15°, and if we mark the place on its neck which corresponds to the surface of the liquid, when we come to raise the temperature of the vessel and its contents to 16°, the liquid will expand, as we have said, to 1·000173 c.c.; but the volume, marked on the glass vessel, will itself expand to 1·000026 c.c., and the expansion of the liquid beyond the line on the glass would be the difference =0·000147 c.c., and the weight of liquid below the line would be—

$$\frac{0.999113}{1.000147} \text{ grms.}$$

If the flask is capable of holding 100 c.c. at 15° up to a line on its neck, the weight up to that line at 16° would be—

$$\frac{99.9113}{1.000147} = 99.8965.$$

By proceeding in the same manner for all temperatures up to 45°, we obtain a series of numbers expressing the weight in grammes, taken *in vacuo*, which will occupy a volume in a glass vessel, which at 15° is equal to 100 c.c. These we place in the second column of Table No. 2.

For temperatures below 15°, we may notice that if we cool down 1 c.c. from 15° to 14° the volume is reduced to $1-0.000124=0.999876$ c.c., and, consequently, to fill up the flask up to the mark representing 100 c.c. at 15°, we must weigh—

$$\frac{99.9113}{0.999876} = 99.9237 \text{ grms.}$$

In the same manner we obtain the weights for temperatures down to 4° C., and we also place the numbers thus obtained in the second column of Table No. 2.

(To be continued.)

THE HISTORY AND WORKING OF THE ALKALI ACTS OF 1863 AND 1874.

In the Report appended to the evidence collected by the Noxious Vapours Commission 1876, just published, an interesting and valuable account of the beneficial working of the Alkali Acts of 1863 and 1874 is given at some length.

The history of the passing of these Acts is instructive. In the year 1862 a Select Committee of the House of Lords was appointed to enquire into the truth of a mass of complaints which had been made for several years previously as to the injurious results of the escape of noxious vapours given off in certain manufactures, as well as with respect to the state of the law upon the subject. The Committee reported that great injury had been done in different parts of the country to vegetation generally, including trees, hedges, corn, grass, and garden-stuff, the chief mischief being from alkali and copper works. As for the effect of the vapours on the life and health of men and animals they declined to express any opinion, as the majority of witnesses seemed to agree that animals were only indirectly affected by feeding on herbage tainted with the noxious fumes.

With regard to copper works they did not recommend that they should form the subject of special legislation, seeing that up to that time no efficient means had been devised for neutralising the vapours evolved in the smelting of copper consistently with carrying on this important

branch of industry; in other words, the members of this very unscientific Committee were effectually hoodwinked by certain clever copper smelters of the period. They consequently confined their attention to alkali works, their great bugbear being hydrochloric acid gas, and reported not only on the evidence of scientific men, but upon that of the manufacturers themselves, that it was perfectly easy to carry on the manufacture without perceptible injury to the vegetation in the neighbourhood. Acting on this evidence, therefore, they recommended that a Bill should be introduced into Parliament which, without specifying the particular process by which every alkali works should consume its own hydrochloric acid gas, should nevertheless enact that a substantial penalty should be attached to the escape of the gas during the process of manufacture. They also recommended the appointment of inspectors with large powers and wholly independent of local control and local influence.

In virtue of these recommendations, a Bill embodying them in substance was introduced by the Government in the year 1863, and was shortly afterwards made law under the title of an "Act for the More Effectual Condensation of Muriatic Acid in Alkali Works," 26 and 27 Vict., cap. 124. Considerable modifications were made in the Bill during its passage through Parliament. The main provisions of the Act were that alkali works should consume not less than 95 per cent of the hydrochloric acid given off during the process of manufacture, the penalties being £50 for the first offence and £100 for the second. The registration of all alkali works was provided for, and inspectors and sub-inspectors were to be appointed by the Board of Trade. The owners of alkali works were also empowered to make special rules for the guidance of their workmen, and punish them by fine in case of contravention. Contrary to the recommendations of the Select Committee it was enacted that the penalties should be recoverable by civil action to be brought in the County Court by the Inspector instead of at Quarter Sessions, the power of removing cases and appealing to higher courts being given to both parties.

The Act was at first looked on as an impracticable experiment, and was intended to continue in force from January, 1864, to July, 1868, but before it expired it was made perpetual.

The first Inspector appointed was Dr. R. Angus Smith, F.R.S., who we may say once for all has been the life and soul of the movement, whether engaged in fighting recalcitrant manufacturers, making reports to the Government, or in giving evidence and making recommendations before the Committees and Commissions. Dr. Smith, in addition to his extensive knowledge as a chemist, has brought with him from the other side of the Tweed a stock of the well known plant called Scotch hard-headedness, which has thriven and borne abundant fruit in spite of all the noxious vapours of Widnes, Runcorn, and St. Helens put together. Four sub-inspectors were also appointed, whose head-quarters were Liverpool, Manchester, Newcastle-on-Tyne, and Glasgow.

The general opinion among chemists and manufacturers has been that the effects of the Act have been beneficial both to the public and the manufacturers, but owing to the Franco-Prussian war and other circumstances the increase in the size and number of alkali works has been so great that it is difficult to estimate the exact amount of good effected. One thing, however, seems certain; that in those districts where no such increase has taken place the improvement has been most satisfactory. Another factor in rendering the results of the Act uncertain has been the great increase in the number of other manufactories evolving acid fumes. Under all circumstances it may be safely decided that the Act of 1863, although very imperfect in its action, nevertheless effected much good in a negative way by the prevention of much injury that would otherwise have arisen. As far as the manufacturers go they have found that the large sums they have expended have not only been not wholly unremunerative, but have indirectly led to an increase in their profits. Dr. Angus Smith maintains—and his opinion is corroborated by several manufacturers—that, taking the whole trade together, the enforcement of the Act has been a gain to the manufacturer. The conversion of the hydrochloric acid into chlorine, which in its turn is converted into bleaching-powder, is undoubtedly a source of profit, and the pressure of the Act has resulted in many instances in improvements in various manufacturing processes, and in the greater economy of raw material and fuel. So far, the good, negative and positive, which was effected by the Act of 1863; but Dr. Angus Smith was far from being satisfied with what he very justly considered such meagre results. He found that the clause of the Act fixing the amount of hydrochloric acid gas to be condensed at 95 per cent was uncertain and unequal in its operation. He therefore set to work to devise a new and more definite standard with which manufacturers, after a certain time spent in experiments, could be expected to agree to. On the other hand, the experience of eight years had taught him that the big bogey of the Select Committee of 1862, hydrochloric acid gas, was not the only culprit concerned in the destruction of vegetation and interference with the comfort of the inhabitants. In his Report to the Board of Trade for 1871 he asserts that the greater part of the injury done to vegetation and the air is not merely due to the action of hydrochloric acid gas, but to the sulphur acids, and goes on to specify the class of works which are specially guilty in this respect. Dr. Smith also declared that there was a great difference in the quantity of sulphur compounds which were allowed to escape from different works. These investigations were pursued for some time, and it was not until 1874 that on the recommendation of Dr. Smith an Act was passed called the "Alkali Act of 1874," 37 and 38 Victoriæ, cap. 43, which enacted that the standard for the escape of hydrochloric acid gas should be fixed at one fifth of a grain for each cubic foot of air, smoke, or chimney-gases escaping from the works into the air. The most important portion of the measure was that which by a new definition of "alkali works" brought "wet" copper works within the scope of both Acts, while the definition of "noxious gas" was so extended as to include sulphuric acid, sulphurous acid except that arising from the combustion of coal, nitric acid, and other noxious oxides of nitrogen, sulphuretted hydrogen, and chlorine, with respect to which every manufacturer was bound to use the best practicable means for preventing their discharge into the air, or for rendering them harmless before such discharge.

This Act came into force in March, 1875, but so many complaints were made on the one side of its inefficiency, and on the other of its too great stringency, that a Royal Commission was appointed in July, 1876, to enquire into the working of both Acts, as well as into the working and management of works and manufactories from which noxious vapours were given off, to ascertain their effects on animal and vegetable life, and to report on the best means to be adopted to prevent their evil effects. The Commission consisted of Lord Aberdeen, Earl Percy, the Hon. Wilbraham Egerton, Messrs. J. C. Stevenson and F. A. Abel, Drs. A. W. Williamson and H. E. Roscoe, and Admiral Hornby.

Within the two years they have been sitting, the members of the Commission seem to have got through a good deal of work. They have visited Widnes, Runcorn, St. Helens, Northwich, Swansea, Tyneside, and the banks of the Thames, and have inspected alkali, cement, and chemical manure works, coke ovens, copper works of all descriptions; glass, lead, nickel, and salt works, and potteries. They have also taken evidence in London, Liverpool, Tynemouth, Newcastle-on-Tyne, and Swansea, and have examined manufacturers, land-owners, farmers, clergymen, and occupiers of houses, lands, and gardens, land agents, scientific witnesses, medical men, and local officers, as well as the Inspector (Dr. Angus Smith) and the Sub-Inspectors under the Acts. Tin-plate works, gal-

vanising works, cobalt and spelter works, they do not seem to have touched, there being no peculiarities about them that should separate them from the other works which emitted noxious fumes, and enumerated above. Gas works they considered beyond their province, inasmuch as so much special legislation had been bestowed upon them.

With a large portion of the evidence brought before the Commission we have little or nothing to do on the present occasion, our intention being to examine the past action of the two acts so frequently mentioned rather than to look into the future.

The complaints against the existing law are numerous, and in certain cases appear well founded.

Mr. Mactear, of St. Rollox, objects to the clause of the Act of 1874 which fixes the standard of escape at one-fifth of a grain of hydrochloric acid. This section, in his opinion, weighs very unequally on manufacturers, rendering it necessary for some of them to dilute their gases with air before allowing them to escape. Mr. Mactear seems, however, to be alone in this opinion, and it seems to be pretty generally agreed amongst other manufacturers that the new mode of testing is superior to that in the original Act.

Dr. B. W. Richardson objects to the provisions of the new Act on logical grounds. He says in his evidence:—"There is only one logical solution to the question of the exact quantity of noxious gas that should be allowed by law to escape, and that is that there should be none." He also considers the expression, "The best practicable means," in section 9 of the new Act to be too indefinite.

Some of the witnesses seemed to be under the impression that the owners of alkali works are absolved from responsibility for the acts of their workmen by the Act of 1874, but this is an erroneous idea, of which they were soon disabused by the Committee.

Dr. Angus Smith considers that the time has come for the fixing of the standards of escape for nitric and sulphuric acid, an opinion in which he is borne out by Mr. Fletcher, the Lancashire Sub-Inspector, and by one or two Tyneside manufacturers, including Mr. Glover, the inventor of the condensing-tower which bears his name.

The clauses of the Acts giving either party the power to move the action into a superior court is greatly objected to by persons of the class of farmers and market gardeners, to whom it is often equivalent to a denial of justice. Mr. Pardey, a landowner at Liverpool, stated that forty actions were commenced in the County Court at the same time, but the manufacturers moved them into a superior court, putting the plaintiffs to such heavy expense that the whole thing was given up, although five or six recovered in some cases that went to arbitration.

Another difficulty seems to exist with respect to mere nuisance. The owners of some houses at Widnes and St. Helens, which were rendered uninhabitable from the sulphuretted hydrogen which escaped from the waste heaps, could not recover damages because there was no physical injury done to their property.

It will be seen from the above extracts from the Report that although the two Acts are objectionable in some respects, that they have certainly effected an immense amount of good, and that by a few additions and amendments they may be transformed into good working laws that will need but little tinkering from our future legislators.

NOTICES OF BOOKS.

Memoir of the late Alfred Smee, F.R.S. By his Daughter. With a Selection from his Miscellaneous Writings. London: G. Bell and Sons.

We have here the life-history of one too early removed from our midst, but who has left behind him abundant proofs of an intense and varied activity. At once a chemist, a physicist, a biologist, a geologist, a photographer, an electro-metallurgist, a medical practitioner, a horticulturist, a sanitary reformer in the best sense of the term, he took a lively interest in public affairs, local and national. The inventor of Smee's battery was also the author of "A Practical Remedy for Extortion and Intimidation practised by the aid of the Superior Law Courts;" of pamphlets on "The Puppet Parliament," on the "Final Reform Bill," on "Locked-up Money," on the "Unseaworthiness of Ships sent to Sea"—a subject into which he entered with a heartiness scarcely inferior to that of Mr. Plimsoll himself—and on "Chancery Reform." Nor was he, as is too commonly the case with men of versatile dispositions, a mere dilettante—a superficial trifler. To all these varied subjects he brought the power of close observation and original thought, and even those who more or less dissent from his views are compelled to own that "nihil tetigit quod non ornavit." It is true that had he even confined himself to some one of the many matters upon which he touched he might have attained in that department greater eminence, and have left to the world more profound researches. But, on the other hand, it is very doubtful whether his varied knowledge was not an essential element in his most important legacy to posterity—his contributions to sanitary science. The sewage question has been complicated no little by the dogmatism of chemists who are neither medical men, nor agriculturists, nor, above all, common sense men of the world.

Those who take an interest in the influence of heredity upon character and ability will be pleased to learn that Mr. Smee's forefathers were distinguished, if not for scientific attainments, yet for uncommon talents and great force of character. Young Smee from his earliest days evinced those peculiarities which followed him through life. Though active, and fond, *e.g.*, of climbing, he never when at school engaged at cricket or the other ordinary amusements of boys. "In after life he never entered into such recreations as billiards, backgammon, whist, or any other game." Though exceedingly humane and kindly, both to his own species and to the lower animals, he was not a humanitarian. "He considered that there are times when animals must suffer for the weal of man, and that morbid sentimentality ought not to be permitted to step in and stop experiments." In his student days he was more of an observer and worker than of a "reader," and in our days of learning in order to "pass" he would have made no brilliant figure. At King's College he carried off, however, the medals for chemistry, anatomy, and physiology, and lost the theological prize by one mark only. It appears, indeed, that from an early age his mind was deeply imbued with religious thought. Nevertheless, in consequence of some of his electro-physiological researches he was in after life most unjustly accused of materialism. His work on "Electro-metallurgy" not merely popularised the *art*, but in great part created it. His election as a Fellow of the Royal Society took place in 1841, before he was twenty-three years old. Did space allow it we ought here to give an account of Mr. Smee's activity in connection with the potato disease, which he ascribed to the ravages of an insect, *Aphis vastator*. In so unscientific a manner was this controversy waged that Mr. Smee received minatory letters by almost every post, and, as we are informed, even his life was threatened.

But we must pass on to a consideration of his treatment of the sewage question, a subject upon which he took a decided stand, and in connection with which he has been grossly misrepresented. It is commonly supposed that to the bigotry of irrigationism he opposed a bigotry similar but antagonistic. He was not an enemy of sewage irrigation, but he contended that it ought to be fairly and properly conducted, as it otherwise became a source of grave danger. He complained, and justly that—"The effect of sewage-grounds, as hitherto conducted, has been as bad morally on the minds of th

people as it has been physically on their bodies. Largely exaggerated statements have been made by their supporters. Facts are suppressed or not fairly given. General denials are made to all complaints. The most insolent observations are made to those who point out their dangers." Among these dangers Mr. Smee points to the very plain fact that, admitting the disinfecting power of soils, still a given quantity of soil cannot go on oxidising and destroying an unlimited quantity of sewage matter. Were this not the case there would be no necessity to close over-crowded graveyards, nor could wells be polluted by the infiltration of sewage through the surrounding soil. If the limit is once passed the earth of a farm becomes water-logged and saturated with filth; the oxidation process is at an end, and the waters must pass off unpurified. He adds the very important caution that "in the choice of a situation, underground channels, capable of directly conveying the sewage to distant parts, should be avoided: for example, chalk strata have cracks probably of miles in length. These cracks or fissures vary from a hair's breadth to a width of nine or ten inches, and if sewage were turned into one of these fissures it might reappear miles off,"—and of course contaminate wells and water-courses where no suspicion of danger exists. He considers that "unless the sewage is defæcated before irrigation a layer of fæcal matter is deposited on the surface of that part of the ground which has no crops upon it, and if there are crops the fæcal matter is deposited upon the plants." From these self-evident facts he infers that "sewage irrigation cannot be practised without creating a nuisance, unless by the previous removal of the solids and the precipitation of the greater part of the dissolved portions of animal matter." Of the possibility of this last operation Mr. Smee was far too sound a chemist to doubt.

As to the effects of feeding cattle upon grass which has whilst growing served as a strainer for excrementitious matter, and whose every stem is coated with filth, there is no room to doubt. If putrescent animal matters are supplied to plants in moderate quantity, these matters are no doubt ultimately assimilated. But such assimilation is a work of time, and until this process has been completed the plants themselves and their juices are offensive to the smell, and enter into putrefaction more rapidly than plants or the juices of plants which have not been watered with sewage. On this subject some interesting experiments have been performed by Mr. A. H. Smee, the son of the subject of the memoir. That organic matters are absorbed by plants without being previously resolved into their inorganic constituents is shown by the phenomena of "carnivorous plants," at which indeed Mr. Smee, who was no Darwinian, seems to sneer. But he follows up the scent, literally speaking, from the polluted vegetation to the polluted milk, butter, or meat. The following extract from a letter to Dr. John Simon, F.R.S., &c., speaks for itself:—"During the spring, my son directed without my knowledge that my cows should be fed with a small proportion of sewage-grass, when without knowing the reason the butter was so offensive that we could not bear it on the table; the other members of the family were loud in their complaints, and the neighbours for a long time came for no more butter. Upon enquiry I heard of the feed of sewage-grass, which was immediately discontinued, when the milk, cream, and butter resumed their former excellence."

The experiment was subsequently repeated without any warning, when the same results again occurred. It was further observed that the milk of cows fed upon sewage-grass underwent decomposition earlier than the milk derived from natural grass, and gave off a much more offensive odour. No one has as yet to our knowledge even attempted to refute the conclusions drawn from these facts. The only argument urged in opposition is substantially that of the thief who offered to bring a hundred witnesses who had not seen him steal anything. Mr. This and Dr. That say that no harm has to their knowledge arisen from drinking sewage-milk. This argument, if it proves anything at all, proves too much. A family may drink the drainage of a cesspool for years without taking any tangible harm, and may consider the water "excellent." But some day the *dejecta* of a patient suffering from cholera or from typhoid fever pass from the cesspool into the well—and then?

Mr. Smee's recommendations are in short that sewage farms should only be laid out in places where the soil is not restricted, and where it is free from fissures, that the sewage should be defecated before application, that its quantity should not be greater than the soil can dispose of, that no vegetables be taken for the food of man or beast unless a month or six weeks have elapsed since the last dose, and that care should be taken that cattle do not drink the sewage. Were these precautions observed he considers that irrigation might be conducted without peril.

It is not possible for us to pursue further an examination of Mr. Smee's views, but we feel convinced that few disinterested and unprejudiced persons can peruse this work attentively without feeling their belief in irrigation rudely shaken. For this reason, but by no means for this alone, we strongly recommend the "Memoirs of Alfred Smee" to all municipal and local officials and to all educated ratepayers. They will find its study both pleasant and profitable.

Report of the Air of Glasgow for the Six Months, November to April, 1878. By E. M. DIXON, B.Sc. (Presented to the Committee of Health of the Magistrates and Council of Glagow, July 29, 1878.

THE author—or rather his successor, Mr. Dunnachie—has adopted an automatic method of air-washing. The air is forced through the absorbing medium by water-pressure, and its volume is measured by a gas-meter. The carbonic acid, sulphur, and chlorine are each collected in a separate series of absorbers, but ammonia and albuminoid ammonia in the same series. The absorbing agents used are—for carbonic acid, a strong solution of caustic potash; for the ammonias, dilute sulphuric acid; for sulphur, dilute permanganate; and for chlorine, dilute ammonia.

Results of a Series of Tests of Cold-Punched and Hot-Pressed Nuts at the Mechanical Laboratory of the Stevens' Institute of Technology, Hoboken, New Jersey.

THIS pamphlet, which is descriptive of certain of the specialities of the firm of Hoopes and Townsend, of Philadelphia, is deficient in one important item. It has no title, and in default we are obliged to take the heading of its most important chapter. The work comprises a history of the firm of Hoopes and Townsend, and an account of the chief articles of their manufacture, especially the "cold-punched nuts." There is also some correspondence with the *Polytechnic Review*, and an account of the comparative trial of "hot-pressed" and "cold-punched" nuts conducted at the Stevens' Institute under the supervision of Prof. R. H. Thurston. The results of the trial are described as showing that the cold-punched nuts possessed a greater average strength, combined with greater rigidity and slightly greater uniformity, than were exhibited by the hot-pressed nuts.

Ultramarines at the Universal Exhibition for 1878.—J. F. Plicque.—The industrial production of green and violet ultramarine is still quite recent, but the qualities of these new products are already highly appreciated. The total annual production of ultramarine in Europe exceeds ten million kilos., its mean price being 2 francs per kilo. In 1820 natural ultramarine cost 4000 francs per kilo.—*Moniteue Scientifique.*

CORRESPONDENCE.

CYANOGEN COMPOUNDS IN ALKALI MAKING.

To the Editor of the Chemical News.

Sir,—In your issue of the 13th inst. (Chem. News, vol. xxxviii., p. 137) there is a letter from Mr. Weldon criticising my communication regarding cyanogen compounds, which you were good enough to insert in the Chemical News of the 6th inst. I shall esteem it a favour if you will allow me to make a few remarks on the subject.

Mr. Weldon seems to misunderstand my statement, which is—That a higher temperature of the mass or charge prevails at the end of the reaction, and that it is then that the formation of the cyanogen compounds takes place. Nothing in his communication has in the least disproved this: on the contrary.

The cyanogen compounds are not produced from the nitrogen of the mixing coal, as is the generally accepted theory of the subject; but these compounds are produced by the action of the highly-heated nitrogen in the gases of combustion from the fuel upon the alkalised carbon in the mass in the furnace. If this carbon can be kept at a minimum, and the heat of *the mass* at the end of the reaction be kept down, little or no cyanogen is formed: this is established beyond any doubt.

In the ordinary "mixing," where much more limestone is used than with my system of making black-ash, the temperature of the mass at the end of the reaction is just so much higher according to the fusing-point of the charge. The temperature of the furnace and the temperature of the mass are two totally distinct things. I keep my furnaces just as hot as I can by burning the maximum of fuel in the grates; but I keep down the temperature of the charge by reducing the melting-point of the mass to the lowest point. I believe that the furnace temperatures I employ are higher than in any other case in the trade, from the great command of draft I have both at St. Rollox and Hebburn, and as furnace outputs of 300 and 330 tons sulphate per week would show; whilst that the melting-point of the charge is much reduced is shown by the fact that as much as 75 per cent additional work has been got through by furnaces working on my system compared with the old method. I am quite certain that in no case in practice does the heat of the charge ever attain to that of the furnace without the most disastrous results as to quality of black-ash produced.

The facts adduced do not oppose, but in my opinion strongly support, my statement, thus:—

1. *Lime-sludge Mixing.*—In all cases of lime-sludge mixing which I am acquainted with (and they are many) a considerable excess of both carbonate of lime and mixing-coal are employed: we have therefore a high fusing-point of the mass, and also large quantities of excess carbon, both of which are highly favourable to the formation of cyanogen compounds,; the only effect of the 50 per cent of water is to lower the average temperature of the furnace, and thus cause the exposure of the mass at the end of the reaction for a longer time to the conditions most favourable to the formation of cyanides.

2. *The Revolver fired with Gas.*—In this case it is clear, from the well-known conditions of gas-firing, that much less excess air would be passing with the gases of combustion, and therefore gas relatively much richer in nitrogen would be acting on the heated mass. No doubt, also, the much lower heat which prevailed in the furnace when fired with gas had the effect of exposing the charges for a much longer time (under the most favourable conditions for the formation of cyanides) to the gases of combustion towards the end of the reaction, when the charge was melted, and alkalised carbon present. The time occupied in finishing a charge being much longer when heated by gas than when heated by fire, the mere change to firing with coal would increase the number of charges made, by shortening the time per charge, and consequently the amount of exposure to the heated fuel gases, especially at the end of the reaction.

3. *Hand-furnace Black-Ash* is made under very different conditions: a great part of the decomposition takes place without contact of the fire-gases at all, and is much assisted by the bottom heat of the furnace; the amount of exposure to the heated gases is therefore less than in the revolver, where the charge is so thoroughly turned over, and less cyanides are to be expected.

4. *French Hand-Furnaces.*—This also is just what is to be looked for. In the French practice a very low amount of mixing-coal is employed and a higher furnace temperature (according to Mr. Weldon); but the charges, so far as I am aware, do not remain longer exposed to the heat while finishing. It is difficult to see how this could be, if the heat was higher, without the charges getting burned. I am certain Mr. Weldon is in error as to the temperature of these furnaces compared with, say, a Lancashire hand-furnace: a comparison of the amount of material melted per square foot in each case would be more convincing than an estimated temperature, which is usually very difficult to compare.

I hold, however, that the question of the temperature of the furnace has little comparatively to do with the matter; it is the higher temperatures of the mass and the presence of alkalised carbon which favours the formation of the cyanides.

5. I must protest against the inference to be drawn from this paragraph. It is unjust, not only to myself, but to many others. The destruction of the cyanides had been sought after and obtained by other methods before Mr. Weldon introduced Mr. Pechi ey's process. Mr. Williamson, of the Jarrow Chemical Works, had been perfectly successful in destroying the compounds in the vat-liquor, and I had been successful in using a process in which hydrate of soda was added at the end with the view of getting rid of the cyanogen by the action of the hydrogen evolved. This was perfectly successful, and Mr. Weldon was told by me of this process many months ago. My experiments on the destruction of cyanogen compounds have been carried on since early in 1874.

6. I am satisfied from my experience of additions at the end of the balling process that the result obtained as described by Mr. Weldon under this head can be readily enough explained from my point of view, partly in the fact that the charge will be stiffened up and in a porous and favourable condition for the action of the nitrogen of the hot gases at the end of the operation.

In the paragraph at the foot of page 137 it appears to me that Mr. Weldon admits my position. He accounts for the cyanogen compounds not being found in the charge in the black-ash furnace till towards the end of the operation, when a high temperature of the mass prevails, by the hypothesis that the quantity of sulphate undecomposed is then lowest, not because the temperature is highest. He thus admits that the cyanogen compounds with which we have to contend *are* formed at the end of the operation, and it is then certainly that a high temperature of the mass prevails.

But, further, he does not prove in the least that the amounts of cyanides depends on the sulphate present, and having been able to obtain black-ash with considerably under 1 per cent of undecomposed sulphate which was free from cyanogen compounds by the simple method of working described in my last communication, I decline to accept his dictum without more proof than has yet appeared.

That sulphates of the alkalies added to cyanogen compounds destroy the cyanide is not a new fact in chemistry by any means, the reactions involved being described in "Watts's Dictionary," in the 1864 edition; but to M. Pechiney most clearly belongs the honour of applying these known reactions practically in the alkali making.

Mr. Weldon (I am sure unintentionally) totally mis-

represents my position when he says—"While, then, Mr. Mactear's idea that a low temperature in the black-ash furnace will help to enable him to prevent the formation of cyanogen compounds;" and I deny most emphatically that it is due to M. Pechiney that English manufacturers are indebted for the great advantages resulting from a reduction of their mixing-coal to a minimum. Mr. Weldon again does me wrong when he says that he urged the use of the minimum of coal upon me when he called on me of his own accord on July 23, as we were both at one on this point, and he should not, I think, quote a figure given off hand in conversation in support of his assertion. I told him that I had been down I believed to 32 per cent, but without consulting my figures, and simply to show that the principle is not new. I find, on looking at the figures in my note-books, that I had actually been down to 28 per cent so far back as September, 1874. I will not discuss the letter from M. Pechiney (a copy of which Mr. Weldon presented to me last time I saw him). It contains much that I agree with, but also much that requires explanation; but I would refer Mr. Weldon, before claiming either for himself or M. Pechiney the credit of introducing a knowledge of the effects of low amounts of mixing-coal, to the papers of Unger, Scheurer-Kestner, and others, but more especially to the masterly investigation of this subject by Kolb.

Mr. Weldon speaks of my adopting the French proportion of mixing-coal; he might have gone further and said the French process invented by Leblanc. He is quite wrong in saying that I use a lower temperature. I believe the temperature is considerably higher in my furnaces than in any French furnace.

He has thought it necessary in discussing a chemical question to make certain statements which he must pardon my noticing very briefly. When I called on him at his hotel in Glasgow, on September 1, it was at his urgent written request, brought by a messenger, he being too ill to call on me, although he had come to Glasgow for the purpose of seeing me. Our interview was long, and many points were discussed and many things said on both sides. I told him all I had done, a little unwisely it would appear, and he showed me certain figures and documents, and made the distinct statement that the opinion he then had was that our two processes must be worked conjointly, and that the "process of the future was a combination of Pechiney and Mactear." I told him that I could do perfectly well without Pechiney, and had no doubts whatever as to my results. I had arrived at the state of finished ash at this time. I had *not* "obtained a finished product made without removing any red liquors, and yet as free from iron and as good in colour as ammonia-ash," nor can I believe M. Pechiney does by his process, as I cannot see how he gets rid of all the double sulphide of iron and sodium (unless it be from the well-known property of NaCl in vat liquor of precipitating sulphide of iron, his liquors containing a very large amount of NaCl). It is the first time I have heard the claim advanced that ash made in this way was as free from iron as ammonia-ash although it may be as good in colour.

I must again say most distinctly that I do not advocate a low furnace temperature; on the contrary, the higher I can keep my furnaces the shorter time there is for the formation of cyanides at the higher temperatures prevailing at the end of the reaction. All experience in connection with the formation of cyanogen compounds from the air goes to prove that the temperature best suited for their formation is a very high one. I am of opinion that the formation of these compounds depends to a great extent on the reduction of the sodic compounds to the metallic state at the higher temperatures. Cyanides are readily enough formed if we pass heated air over a mixture of powdered coke and metallic sodium at a red heat (sodic oxide is given off in white fumes, which are most difficult to condense, even passing not only through water, but through dilute sulphuric acid). They are still more eadily formed when nitrogen is employed instead of air.

That black-ash can be made as free from cyanogen compounds by other processes than that of M. Pechiney is a fact, and I do think something may be gained. The sulphate added at the end of the process it is claimed is decomposed into carbonate, but with the evidence I have had placed I prefer merely to state that I do not see how it can be so, and that the results do not show it to be the case.

The formation of cyanides may be prevented as I pointed out, or they may be destroyed after formation by the use of hydrates, such as sodic hydrate, or they may be destroyed by the addition of the earthy sulphates, or by metallic oxides, such for instance as oxide of iron; ½ per cent of "blue billy," or refuse oxide of iron from the copper works, having proved sufficient to destroy the cyanides in black-ash that I have made by my ordinary processs, without affecting prejudicially the vat liquors.

The claim advanced for M. Pechiney's process in the concluding part of the letter wants a great deal of confirmation.—I am, &c.,

JAMES MACTEAR.

September 21, 1878.

THE PRINCIPLES OF COMMERCIAL CHEMISTRY.

To the Editor of the Chemical News.

SIR,—I have been an interested reader of the letters which have appeared lately in your valuable paper respecting "The Principles of Commercial Chemistry." As the manager of a works which consumes nearly 3000 tons per annum of sulphate of ammonia, and having had a number of years' experience in that article, I would like to give you the results of that experience in so far as the present question is concerned.

Good grey sulphate of ammonia invariably tests 24·50 per cent to 24·75 per cent. Darker coloured sulphate of ammonia tests 24·25 per cent; while that from the States, which is pure white and kiln-dried, tests 25 per cent. As regards the price: American ammonia invariably commands 10s. per ton more than good grey. Good grey commands 5s. per ton more than dark ammonia, and the price of the latter at present is £19 15s. to £19 17s. 6d., delivered at ——, and guaranteed 24 per cent. With respect to the altering of the present standard, there are a great many objections to it. How many manufacturers, may I ask, deliver their ammonia much over the 24 per cent? One half of the makers which supply us no sooner get their sulphate made than they ship it, in order to get their money, and it is shipped in such a condition as to prevent all possibility of its testing much over 24 per cent, and this merely on account of moisture, and if it had been dried through long storing would have shown 24·75 quite easily. Again, if the guarantee were made 24·75, the line being drawn so fine, the disputes with chemists would be endless, and the cost of a confirmatory analysis over little lots of 5 tons, &c., would soon sweep away the benefit. "In a Fog" has his remedy for the 0·75 per cent (which he would lose were he not such a good manufacturer) by guaranteeing 24·75 per cent, and people who know their business will pay him for it. At the present moment we get some lots of "good grey" made by those proverbially bad chemists, "Gas Works Managers," which are perfect samples of sulphate of ammonia, and for which we never hesitate to pay 10s. per ton more than we pay for dark lots, as they invariably test 24·75 per cent.—I am, &c.,

WORKS MANAGER.

COMMERCIAL SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—I am sorry again to take up your valuable space in reply to your correspondent, "In a Fog." His so-styled "practical commentary"—and this, too, after his professed ignorance—lends a different aspect to the argument, and

explains also his jealousy (he a manufacturer himself) of Corporation Gas Companies and other makes superior to his own, the latter not having as yet solved the difficulty of making an *exact* 24 per cent in the ordinary way of working. And I have still my doubts whether your correspondent's sulphate, under these circumstances, is of proper quality, a large make, judging from the figures given, though it be. "In a Fog" need not remain long in doubt about what other makers produce if he will ask for samples and test them. I know from facts that most of the "good grey" is invariably over 24 per cent, and for this reason there will be great difficulty in getting consumers to pay immediately the equivalent of 1 per cent more, although not one in the trade would object to see a minimum guarantee of 25 per cent established and the market rates ultimately regulated, thereby doing away as it would with some of the disputes now sometimes arising. But as a 25 per cent is *not* made "with ease," in fact, as it could not be relied upon according to the present mode of manufacturing, I think manufacturers themselves would be the first to return gladly to the old standard. What "In a Fog" is aiming at is to sell on a basis of 24 per cent or per unit of ammonia; but of course in such a case every single parcel would have to be analysed, and this, taking into account how analytical chemists differ, would hardly be practicable, even leaving the great trouble and inconvenience occasioned thereby out of consideration. And does not your correspondent quite overlook the fact that the manufacturer guarantees 24 per cent *minimum*, and that if he cannot be compelled to deliver a product containing even 1-10,000th over the percentage, still his endeavouring in the final process to reduce the strength would barely be honest, and I am happy to say I know of no manufacturers who rack their brains for such a purpose, and "In a Fog" seems simply to have been stating his own case. If "In a Fog" had carefully read my letter it would have saved the repetition of some of my former remarks. I did not say it would require "prolonged draining or artificial drying" to reach 24·75; I referred to 25 per cent @ 25·25 per cent. And respecting the colour "superstition," I do not see what bearing it has upon the argument, but it is well known that very little prejudice exists now, white being not often asked for, although it is given the preference at same price.—I am, &c.,

J. H.

AMMONIACAL LIQUOR.

To the Editor of the Chemical News.

Sir,—As it seems to be becoming more general among gas corporations and companies to sell their ammoniacal liquor, not at so much per degree of Twaddell's hydrometer as formerly, but on the basis of the actual strength of ammonia, and as one of these (Leeds, in a recently issued form of tender) is now stipulating that this shall be determined by the so-called "Wills's test," which consists in the old plan of boiling the ammonia into test acid with caustic soda, I think it desirable to draw the attention of those of your readers who may be interested to a paper published in the Chemical News, vol. xxxi., pp. 15 and 16, "On the Distillation of Ammonia in Presence of Sulphocyanides," in which it is experimentally proved that caustic soda tends to convert a portion of the sulphocyanide into ammonia; and that caustic lime, which has no such action and expels the ammonia quite as freely, should be substituted.

Should it not suffice in commercial contracts to specify that the actual percentage of valuable constituent shall be taken without stipulating that it shall be decided by a particular test which (as has been the case in this instance) may any day be demonstrated to be incorrect?—I am, &c.,

Alexander Esilman.

Manchester, September 9, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 10, September 2, 1878.

Diffusion of Cerium, Lanthanum, and Didymium.—M. Cossa.—Certain specimens of scheelite, especially those from Traversella, and also the apatite of Jumilla, show the black absorption-band characteristic of the compounds of didymium. The presence of this metal gives reason to suspect cerium and lanthanum also. In fact, a few grammes of the scheelite of Traversella are sufficient to show the three metals by the ordinary methods of separation. Spectroscopic examination shows the presence of didymium more or less distinctly in the apatites of Capo di Sales, Cerno, Mercado, Miask, Sreiner, Snarium. Cerium can be detected in all these by chemical methods. The author has also found the three metals in the compact scheelite of Meymac, in the staffelite of Nassau, in phosphorites, osteolites, and coprolites from various sources. He detects them also in the saccharoid marble of Carrara, and in the shelly limestone of Avellino. In bone-ash, as used for the preparation of cupels, he has found 3 centigrms. of the oxalates of the three metals per kilo. He considers that these metals are very widely diffused in nature, and that they enter into the composition of organised beings.

No 11, September 9, 1878.

Novel Effects Produced in the Telephone.—M. du Moncel.—The author, after describing certain experiments which support the theoretical ideas which he put forward in March 1878, adds that they are further confirmed, at least as far as the molecular vibrations are concerned, by the receiving microphones, which are now improved so as to enable speech to be heard almost as well as with a Bell's telephone under the influence of a Leclanché battery of three elements. A simple morsel of charcoal adapted to the centre of a disc of copper, and upon which bears, under a pressure capable of being regulated, another fragment of charcoal on an elastic support—this is the whole apparatus, which may be used for transmitting as well as for receiving. With this system employed as a transmitter very interesting effects may be observed. If the regulating screw is slackened so that the vibrations of the plate may produce interruptions of the current, and if the current of the battery is passed through a small induction coil, the induced current of this coil passing through a telephone, in the current of which are interposed the two armatures of a small condenser, airs sung before the transmitter will be repeated at the condenser.

Variations of Intensity which a Currrent Undergoes on Modifying the Pressure of the Contacts which Establish the Circuit.—M. Trève.—If the current of the electro-magnet of Faraday or of Ducretet is closed between its two poles there is generally observed neither spark nor noise. On suddenly opening the circuit there is heard a detonation almost equal to a pistol-shot, as was first pointed out by De la Rive. This experiment renders it possible to demonstate to a very numerous audience the influence of the pressure of contacts.

Application of the Telephone to the Determination of the Magnetic Meridian.—H. de Parville.—If in the ordinary telephone the short magnetic bar is replaced by a rod of soft iron of at least a metre in length the apparatus transmits sounds with an intensity which varies according to the direction of the rod. The maximum intensity of sound is received when the transmitter lies in the direction of the magnetic needle, and gives place to silence more or less complete when the telephone is

placed in a plane at right angles to the magnetic meridian. If a transmitting telephone with a long rod is fixed upon a Cardan's suspension it can be easily made to traverse the horizon. When the receiver communicating with the apparatus remains silent the transmitter is at right angles with the magnetic meridian. We may thus determine, not merely the direction of the magnetic needle, but, approximately at least, the variations of magnetic intensity.

Constitution of the Inactive Glucose of Cane-sugars and Treacles.—U. Gayon.—This inactive glucose is resolvable into a mixture of dextro-rotatory and lævo-rotatory sugars.

Moniteur Scientifique, Quesneville.
September, 1878.

Certain Interesting Facts in Toxicology.—Prof. F. Selmi.—When arsenic is deposited in the form of a ring or a spot one of the methods for its recognition consists in oxidising the deposit with nitric acid, evaporating gently to dryness, dissolving the residue in water, and testing with ammoniacal nitrate of silver; if during the oxidation arsenious acid is produced a yellow precipitate falls, but if arsenic acid the precipitate is a brick red. In practice, and especially when the quantity of arsenious acid is small, the complete oxidation of the arsenic is difficult, the evaporation having to be very carefully conducted for fear of volatilising a little arsenious acid not yet transformed. If the treatment with nitric acid is not several times repeated it may happen that the slight precipitate with nitrate of silver appears of an uncertain reddish yellow tint, which passes rapidly to a brown by the decomposition of the arseniate of silver. The author finds that the reactions of arsenious acid are more distinct than those of the arsenic, the light yellow precipitate of the former passing less readily into a brown than does the arseniate. In order to determine that arsenious acid shall always be produced he operates as follows:—The part of the tube containing the arsenic is cut off with the file so as to form a small glass ring containing the product. It is placed vertically in a capsule and a few drops of nitric acid are allowed to fall upon it from a pipette, in such a quantity only that it may remain enclosed by the capillarity of the tube. If the ring of arsenic is slight it is dissolved almost instantly; if it is somewhat thick time is required. In case it does not dissolve completely the liquid is removed with a pipette and the acid is renewed, touching with an iron wire slightly heated the *outside* of the tube opposite the place where the undissolved arsenic lies until it is completely taken up. The nitric acid used is prepared by mixing 1 vol. of pure nitric acid of sp. gr. 1·25, and 1 vol. of distilled water. The liquid is withdrawn and the tube rinsed with a few drops of distilled water. Ammonia is added till the reaction is alkaline, and if the volume is too considerable the whole is concentrated in the water-bath. After concentration a little more ammonia is added. A drop of a neutral and very dilute solution of silver nitrate is let fall into the liquid. If a yellow precipitate is formed, the author observes if a second, third, and fourth drop added successively augment the precipitate. The precipitate is allowed to settle, the liquid is removed as completely as possible with blotting paper without touching the precipitate, and it is treated with hydrosulphate of ammonia. The yellow precipitate dissolves, and silver sulphide remains. The precipitate is dissolved in weak nitric acid, and the silver is thrown down with a few drops of hydrochloric acid. The liquid is filtered and mixed with sulphuretted hydrogen and kept at a gentle heat for twenty-four hours, when the arsenic re-appears as sulphide. Another reaction of arsenic indicated by Fresenius and Pettenkofer is of great use for converting the arsenical ring directly into arsenic sulphide by means of a current of sulphuretted hydrogen. The regularity of this reaction has been called in question, but the author has repeated it several times and always with full success. If two or three arsenical rings have been produced this reaction may be applied as a check-test. For this purpose the ring is inserted in the delivery tube of an apparatus producing pure sulphuretted hydrogen, and the part of the tube where the arsenic lies is gently heated, when the metallic aspect of the ring changes to a yellow, more or less inclining to orange, the ring not being displaced. The tube is allowed to cool, and there is poured into it a little sulphide of carbon, which dissolves the free sulphur deposited around the ring. On pouring away the liquid the arsenical deposit appears much more beautiful. The ring in a tube may be also treated as follows:—A few grammes of zinc sulphide obtained by precipitation, and mixed up with water so as to form a paste, are introduced into the end of the tube. The same end is then plunged into a few c.c. of dilute sulphuric acid, and the ring is heated, when the red sulphide is produced.

Volatilisation of Arsenious Acid.—In chemical treatises there appear contradictory statements concerning the temperature at which arsenious acid gives off vapours. According to Thenard volatilisation begins at a cherry-red heat; according to Berzelius, if heated in open vessels, it softens and begins to sublime at incipient redness. In the *Encyclopedie Chimique* it is said to soften and sublime under an ordinary pressure at 200°. Wurtz gives the same degree but without mentioning the softening. According to Watts ("Dictionary of Chemistry"), it begins to sublime at 218°, and according to Wormley at 190°. The author finds that it volatilises at much lower temperatures, especially when assisted by the evaporation of a liquid in which it is contained. Under these circumstances it is more or less volatile at temperatures ranging from 100° to 150°.

On M. A. Gauthier's Process for the Detection of Arsenic.—Prof. Selmi shows that in this process there may occur loss of arsenious acid. He modifies it as follows:—100 grms. of the suspected matter are heated with 20 grms. of pure nitric acid until reduced to a yellowish pulp. The heat is then withdrawn and 5 grms. of sulphuric acid are added. The mixture is heated again till white fumes begin to escape, when 10 to 12 grms. more of nitric acid are added, and heat is applied till a small portion gives with boiling water a dark yellow liquid. It is then filtered, washed repeatedly to ensure complete exhaustion, the liquid evaporated, and the residue taken up repeatedly with hot nitric acid until the solution becomes a light yellow. Sulphurous acid is then added in excess, the liquid is saturated with sulphuretted hydrogen, and left for a day at a luke-warm temperature, taking care that there shall be always an excess of sulphuretted hydrogen. On operating in this manner there is neither loss of arsenious acid during carbonisation nor is any arsenic retained in the organic matter.

Detection of Blood upon Dyed and Dirty Tissues.—If a spot of blood has dried upon a coloured tissue it is difficult to demonstrate the formation of crystals of hematin unless the spot is large enough to be removed mechanically. If the spots are small and the blood has been absorbed by the tissue it is necessary to steep the portion of cloth either in luke-warm water, ammonia, acetic acid, &c., and it often happens that the dye dissolves at the same time, and hinders the formation of the characteristic crystals. The author has observed that the tungstate of soda and acetic acid precipitate foreign matters along with the colouring-matter of the blood, and has examined if the colour-matter of the blood not dissolved would yield crystals of hemine. For this purpose the precipitate, filtered and drained, was put in a suitable vessel along with alcoholic ammonia, prepared with 8 vols. of absolute alcohol and 1 vol. of concentrated ammonia. After being left in contact for several hours the liquid became slightly coloured; on concentrating it gently to a small volume, and then further evaporating it upon a plate of glass and adding to the dry residue a drop of acetic acid and a drop of solution of chloride of sodium,

crystals of hematin were obtained by the ordinary process.

Theory of Alcoholic Fermentation according to the Latest Researches of Claude Bernard.—C. Blondeau.—The author seeks to establish the four following principles:—The ferment exists pre-formed in the interior of fermentescible bodies, and is not brought by the external air in which it does not exist. The ferment is secreted by organised cells which have arrived at a certain stage of their development; it is soluble and acts in the manner of diastases, changing the constitution of bodies with which it is found in relation, decomposing them, and determining the combination of their elements in forms generally more simple than those which originally existed. The presence of air is necessary to the life of the ferment, which finds in atmospheric oxygen the excitation necessary to its development and to the maintenance of its existence. Oxygen intervenes not merely to excite the vitality of the ferment, but further to burn the alcohol produced in the act of fermentation, and to furnish in consequence of such combustion the animal or vegetable heat necessary for the exercise of vital functions.

Chemical Industry at the Universal Exhibition of 1878.—A. Kopp.—*Bleaching:* The author gives an account of various improvements latterly introduced or suggested. Van Baerlé makes use in cotton bleaching of a sulphurous silicate, a clear solution of an alkaline silicate, and a sulphite. The raw material is steeped for twenty-four hours in this liquid at 2° B., passed immediately into hydrochloric acid at the same strength in a washing-machine, washed in cold water, and chlored slightly, and again washed in much water. According to Grothe soluble glass is successfully applied in bleaching cotton. In class 47 of the chemical products is found the chlorozone of Dienheim-Brochoki, a so-called new bleaching-agent with an alkaline base. It is merely the solution of a caustic or carbonated alkali, saturated in the cold with a current of hypochlorous acid mixed with a current of air. The use of alkaline permanganates followed up by an acid, as proposed by MM. Tessié du Motay, Rousseau, and Maréchal is not now in use for any textile fibre. The solutions of certain sulphides, such as those of sodium, calcium, &c., have proved still less successful. M. Tessié du Motay's proposal to use barium peroxide for bleaching tussah silk has proved practically successful. M. C. Girard submits silks to the following processes:—A bath of weak hydrochloric acid removes all calcareous matter; the "ungumming" is then performed by means of carbonate of soda or caustic soda, marking 2° B., followed by rinsing; then follow baths of weak hypochlorite of ammonia varying in number according to the nature of the material, a passage in hydrochloric acid followed by rinsing, and a bath of slightly ammoniacal oxygenated water succeeded by a final washing. The hypochlorite of ammonia is prepared by decomposing sulphate or carbonate of ammonia with a solution of hypochlorite of lime. The bleaching is partly performed in the cold, and lasts for several days according to the nature of the fibre.

Atti della R. Accademia dei Lincei.
1877-78. Serie Terza. Transunti, vol. ii.

On a Poisonous and Crystalline "Ptomain," extracted by means of Ether from the Viscera of Two Exhumed Corpses in which Arsenic had been found in Plenty.—Prof. Selmi.—The author gives a very full description of the reactions of this alkaloid, but he has not determined its composition.

The Physiological Spectral Phenomenon of Dr. G. Colasanti.—By this name the author signifies the phenomenon recently described by Boll: a luminous aureola, composed of lucid points, observed when the central aperture of an eye adjusted to a distant object is struck by a homocentric pencil of very intense light. The dimensions of the aureola vary within the spectral colours. It begins small with the red ray (6°), rises to 15° in the orange, and in the yellow to 30° (on the line D.) It arrives at its maximum, 36°, between D and E in the yellowish green, and diminishing rapidly, reaches 6° on the line G in the violet.

Lining of the Eye in Mammiferous Animals.—Gaetano Mazzoni.—The so-called crystals of Réaumur consist of a mixture of guanin and xanthin, with a small quantity of hypoxanthin.

Occurrence of Tin at Campiglia.—M. Blanchard.—Ores of tin, to an extent capable of being worked, appear to be found at Monte Valerio, Cento Camerelle, &c.

NOTES AND QUERIES.

Indelible Ink.—Requiring an indelible ink that would do without heating, and being unable to get any information here, I began some experiments myself and succeeded in some measure. I find that an ink can be made from hydrochlorate of aniline and red prussiate of potash in two solutions to be mixed when wanted. This ink requires no heating and will not wash out, but is acted on at once by *mango*.* I added a little bichloride of copper, which is an improvement, but does not effectually resist the mango. I tried Blackwood's jetoline, and find it no better. The *English Mechanic* published a recipe for an ink said to be chemically indelible, but mango takes it out entirely. The principal ingredients of it are hydrochlorate of aniline in one solution, and bichloride of copper and ammonia in the other. I would be very thankful for a recipe for an ink that would require no heating and not be changed by chlorine, &c., and if possible be in one preparation.—T. W.

* "Mango" is a trade name for solution of chloride of lime, and is largely used in public laundries for making the linen white.

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c

Now ready, No. LX., *October*, 1878, price 5s.

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Notices of Scientific Works, Scientific Notes, &c.

London: 3, Horse-Shoe Court, Ludgate Hill, E.C.

KING'S COLLEGE, LONDON.
EVENING CLASS DEPARTMENT.

WINTER SESSION, 1878-9.

CHEMISTRY at 7 p.m., Monday, October 7th; Thursday, October 10th. Mr. W. N. HARTLEY.
ANALYTICAL CHEMISTRY, from 7 till 9 p.m., Tuesday, October 8th. Mr. W. N. HARTLEY.

Fee for the Course of Lectures, £1 11s. 6d.; for the Laboratory, £2 2s. The Session terminates in March.

TO TAR DISTILLERS AND OTHERS.

The Directors of The Gas Light and Coke Company require the services of a duly qualified person as manager of their Tar Works at Beckton, under the supervision of the Resident Engineer of the Station.

He must possess a knowledge of Chemistry and be thoroughly acquainted with all the details of the distillation of Tar, and also be able, if required, to design and superintend any addition to the Works which may become necessary.

Salary, £500 per annum.

Applications in writing accompanied by Testimonials, stating age and experience, should be addressed to me on or before Thursday, the 10th October.

(By order)
JOHN ORWELL PHILLIPS,
Secretary.

Chief Office,
Horseferry Road, Westminster,
September 20, 1878.

THE CHEMICAL NEWS.

VOL. XXXVIII. No. 984.

ON THE

ESTIMATION OF MINERAL OIL OR PARAFFIN WAX IN MIXTURES OF EITHER OF THESE SUBSTANCES WITH OTHER OILS OR FATS.*

By WILLIAM THOMSON, F.R.S.E.

MIXTURES of mineral oil with other oils or fats for lubricating purposes have lately become of very general use, and as the problem to determine the percentage of mineral oil in such mixtures has many times been presented to me, I made a series of experiments with a view to devise a quick and accurate process for its estimation, and consider I have been successful in doing so, the process being equally applicable to the estimation of paraffin wax in mixtures of that substance with stearine or other fats or oils.

The principle adopted has been before suggested, but from the manipulative difficulties connected with the published process, I was unable to obtain any results by following it, whilst other published processes I found to be entirely erroneous.

The principle worked out was the saponification of the animal, vegetable, or fish oils or fats, with an alcoholic solution of soda, and the separation of the unsaponifiable oil or wax by means of light petroleum spirit, and the following gives the minutiæ of the process, which was arrived at after many trials with known mixtures :—

200 grs. of the sample to be analysed are placed in a 10 ounce deep porcelain basin, and 350 grs. of an alcoholic solution of caustic soda (containing 9 grs. Na_2O in every 100 grs. measure of solution) added; the mixture is stirred, and heated to ebullition, and allowed to boil until the whole mixture begins to froth up: about 200 grs. measure of distilled methylated spirit are then added, and heat again applied till the resulting soap, &c., is dissolved. 90 grs. of bicarbonate of soda are now added and stirred into the mixture in small quantities at a time, to convert the uncombined caustic soda into carbonate, and, lastly, 500 grs. of previously washed and ignited mortar sand is added to the contents of the basin, and the whole intimately mixed together by stirring, the heating or boiling being continued for a few minutes longer over the Argand burner. The basin, with its contents, is now placed on a steam-bath until the last trace of alcohol or water is expelled, and the whole allowed to cool, and the contents of the basin carefully transferred to a clean, dry, wide-mouthed, stoppered bottle, of about 30 ounces capacity. The bottle is then filled about a quarter full and shaken with petroleum spirit which has previously been distilled at a temperature not exceeding 190° F. The stopper is then cautiously removed, and the bottle filled nearly full with petroleum spirit, and again shaken. The soap and sand separate very readily, the sand having a very remarkable power of bringing down the soap with it, leaving a clear liquid containing the mineral oil or wax, which is syphoned off through a filter of asbestos in the bottom of a 4½-inch funnel (paper filters are apt to become clogged with the soap). The bottle is again filled and shaken with petroleum spirit, and the clear liquid again syphoned off from the soap and sand; a third treatment with petroleum spirit suffices to remove all the mineral oil or wax, and the residual sand and soap may be thrown on a cloth and pressed to remove all the liquid from the plastic mass. The liquors containing the mineral oil are put, or filtered through paper if necessary, into a 40-ounce glass flask fitted with cork and condenser, the flask placed in a vessel of boiling water, and the spirit distilled off, which it does very rapidly.

When the whole of the petroleum spirit solution has thus been concentrated it is transferred to a 15-ounce flask provided with a hole blown in its side, into which fits a cork bearing a thermometer and small glass tube, all of which together have been previously tared. This flask is then placed on a sand-bath on its side, and the spirit further distilled off, being allowed at first to condense in a Liebig's refrigerator; afterwards this is detached when the thermometer, which must dip into the liquid, registers about 220° F. A current of dry air is now blown through the tube in the cork which expels the last trace of spirit, and the flask is then wiped with a clean cloth, and the whole arrangement with the oil or wax is allowed to cool and weighed, and the oil thus found calculated on the quantity originally taken.

There are, however, small corrections which should be made, because so-called saponifiable oils or fats contain small percentages of oils or fats which cannot be saponified and are dissolved by the petroleum spirit. As an example of this I give a few results :—

1. 25 grs. of Russian tallow were taken, saponified, and the resulting soap treated with petroleum spirit as above described, and 0·16 gr. of soluble matter was left, equal to 0·64 per cent.

2. A mixture was made of paraffin wax and tallow in the following proportions :—

Paraffin wax	150 grs.
Tallow	50 ,,
	200 ,,

This mixture was saponified, and the paraffin separated as above described and weighed. The amount found was 150·45 grs.; if tallow contains 0·64 per cent of unsaponifiable fat, then 50 grs. will give 0·32 gr.; total 150·13 grs. Taking this correction into consideration the mixture was found to contain 75·06 per cent instead of 75·00 per cent, giving an amount of 0·06 per cent in excess of that which the mixture contained.

3. A mixture was taken composed of :—

Mineral oil	50·05 grs.
Olive oil	150·05 ,,
	200·10 ,,

This was submitted to the above process, and the unsaponifiable oil found was 51·64 grs.; I know from previous experiments that olive oil leaves some unsaponifiable matter soluble in petroleum spirit, but have not estimated accurately its amount, assuming, however, that it contains the same amount as tallow, viz., 0·64 per cent, the 150·05 parts would give, say, 0·96 gr.; leaving for mineral oil 50·68. Calculating these results to per cent, the mixture contained of mineral oil, 25·01 per cent; found by analysis, 25·32 per cent.

Other analyses were made in duplicate of mixed oils, the compositions of which were unknown, and the results obtained agreed very closely with each other. In conclusion I have pleasure in acknowledging the aid I have obtained through the care and perseverance with which my assistant, Mr. Peter Henry Walsh, has carried out the experiments connected with this investigation.

Royal Institution, Manchester.

* Read before the Chemical Section of the British Association, Dublin, 1878.

Adulteration of Potassium Bitartrate.—According to a paper by Dr. Squibb in the *Druggists' Circular*, the amount of true cream of tartar in this drug ranges from 92 per cent down to 10 per cent, the remainder consisting of tartrate of lime and *terra alba* (ground alabaster).

A NOTE ON CHLOROPHYLL.

By A. H. CHURCH.

DURING some inquiries, which have now extended over three years, into the nature of the red pigment of beet-leaves, I obtained as a by-product a considerable quantity of crude chlorophyll. It had been extracted by means of ether from some hundreds of the dried leaves of a red-leaved variety of the garden beet. After removal of the ether the residue was exhausted with cold alcohol of 85 per cent, in order to effect at least a partial purification of the chlorophyll. The chlorophyll from the alcoholic solution was dried *in vacuo* over oil of vitriol, light being excluded. The product was not of a very satisfactory colour, and was left for a time without further attention. After the lapse of a few months the mass had become of so unpleasant an olive-brown hue that any idea of further work upon it was abandoned. But after some consideration it seemed a pity to throw away a substance which had been obtained with so much labour. And it struck me that some clue to the constitution or relationships of chlorophyll might possibly be secured by submitting my product, altered though it seemed to be, to the process of destructive distillation in contact with zinc dust. Accordingly the dark mass of chlorophyll was mixed with four times its weight of zinc powder, and placed in the water-oven for an hour or two. To my surprise its green colour was not merely restored—it became far more intense and characteristic in hue than the best sample of leaf-green I had ever before seen. The red fluorescence and spectral bands of its alcoholic solution were, moreover, those of the unchanged pigment. It would therefore seem that the gentle reducing action to which the pigment had been submitted when warmed with the metal in the presence of moisture had brought it back to the state in which it existed prior to its removal from the plant and exposure to the oxygen of the air. I trust to be able to pursue this promising line of research. After all, my original intention was carried out, and a considerable portion of the brilliant green mass still containing zinc (together with some sand to prevent frothing) was distilled in a current of dry hydrogen. It yielded about 30 per cent of its weight of an oily distillate, the less volatile portions of which solidified into a crystalline mass on cooling. Ether dissolves this distillate with a blue fluorescence; caustic soda solution does not appear to dissolve or affect it. It seems to be a mixture of not less than three substances, possibly hydrocarbons, but as yet not identified.

Cirencester, September 9, 1878.

THE BEHAVIOUR OF NATURAL SULPHIDES WITH IODINE AND OTHER REAGENTS.*

By H. CARRINGTON BOLTON. Ph.D.

IN a paper on the "Application of Organic Acids to the Examination of Minerals," presented to the Academy about a year ago,† we endeavoured to show that citric (or tartaric) acid and potassium nitrite can be advantageously added to the usual list of dry reagents employed in the determination of minerals. Owing to the facility with which the latter reagent is decomposed by the former, nitric acid can be carried practically in the solid form; hydro-potassium sulphate, already in use,‡ furnishes sulphuric acid in a solid state; and remains therefore to provide for hydrochloric acid, or chlorine. The alkaline chlorides, however, resist the action of organic acids; and a few experiments with easily decomposing sulphides yielded only negative results. Iodine, on the other hand, while less powerful than chlorine, possesses similar properties, and in aqueous solution it attacks many minerals, giving rise to characteristic phenomena.

The employment of bromine in analytical operations* has already demonstrated its power in decomposing natural sulphides; and it is precisely with these minerals that the most satisfactory results are obtained by the action of iodine.

The specimens named below are the same as those whose source and condition have been described in the paper referred to. The method of examination is exceedingly simple; the minerals in fine powder are placed in test-tubes, a small quantity of pulverised iodine is added, and then water poured on; after standing in the cold for some hours (usually over night), the results are noted; the contents of each tube are then heated to boiling, and the results again recorded. The solutions were tested by suitable reagents after expelling by heat the excess of iodine.

Stibnite, treated in the manner described, is strongly attacked; and with excess of iodine the solution turns deep brown-red. On boiling the red solution, it loses colour as the iodine volatilises, and after the latter is completely expelled, suitable reagents demonstrate the presence of sulphuric acid and of antimony. The decomposition of this mineral is complete.

Molybdenite is not attacked either in the cold or on boiling.

Argentite is attacked in the cold, yielding a red solution and a yellowish white precipitate. If an excess of iodine be present, the mineral is completely decomposed in the cold.

Galenite is decomposed in the cold, the liquid being completely decolourised. Lustrous, yellow crystals of plumbic iodide form on the surface of the mineral. On heating, the action is increased; and the solution deposits, on cooling, large and abundant crystals.

Bornite is strongly attacked in the cold, the solution being brown-red and the residue yellowish-white. On heating, the decomposition is hastened, and a heavy precipitate of cuprous iodide forms.

Sphalerite is strongly attacked in the cold, the solution turning dark red and crystalline precipitate forming. On heating, the decomposition is complete.

Chalcocite is strongly attacked in the cold, the solution with excess of iodine being brown-red. On the application of heat, the action is increased, but little (if any) cuprous iodide forms.

Cinnabar is strongly attacked in the cold. On heating, it is readily decomposed, with formation of small scarlet crystals of mercuric iodide.

Pyrrhotite is strongly attacked in the cold; the solution is not completely decolourised, and becomes darker on heating.

Pyrite is decidedly attacked in the cold; on boiling, the action is increased, but the decomposition appears to be incomplete.

Niccolite is strongly attacked in the cold, yielding a green solution, which turns brown on heating with excess of iodine.

Smaltite is strongly attacked in the cold, forming a brown-red solution; heat increases the action.

Chalcopyrite† yields a deep red solution in the cold; the action is increased by boiling, but no precipitate forms.

Tetrahedrite, *ullmannite*, and *arsenopyrite* behave like chalcopyrite.

Bournonite yields a deep-red solution in the cold; and on heating, a heavy precipitate falls, which is evidently a mixture of plumbic iodide with yellowish-white cuprous iodide.

* Read before the New York Academy of Sciences, March 18, 1877.
† *Annals N. Y. Acad. Sci.*, vol. i., p. 1.
‡ Distinction of Natural Sulphides by Bisulphate of Potassa; E. Jannettaz (Transl. from *Comptes Rendus*). *Am. Chem.*, iv., 450.

* P. Waage; *Zeitschr. anal. Chem.*, 1871.
† Meusel has studied the behaviour of chalcopyrite with hydriodic acid; *Ber. Chem. Ges.* iii., 123, 1870.

From the preceding notes, it appears that molybdenite is the only one of the seventeen sulphides examined, which resists the action of an aqueous solution of iodine. The reactions of galenite and cinnabar are characteristic and beautiful; that of bournonite discloses its composition very satisfactorily. The difference of behaviour between bornite and chalcocite is marked.

The results obtained with pyrite and pyrrhotite require some explanations. Professor Henry Wurtz,* in 1858, employed iodine-water to separate pyrrhotite from pyrite; he states that pulverised pyrite digested for 48 hours in the dark with a brown solution of iodine (pulverised and washed repeatedly to remove all free acid), "did not remove the brown colour of the liquid, and the latter had dissolved but a trace of iron." We repeated this process, observing all the precautions mentioned, and found that pyrites (from Colorado and from Saxony), was decidedly attacked. Possibly the discrepancy is only one of judgment as to the amount of decomposition which ensues, but under ordinary circumstances we are confident that iodine (in excess) with water decomposes pyrite.

Besides the natural sulphides, we examined the action of an aqueous solution of iodine on a few minerals belonging to various classes. Limonite, hematite, magnetite, and the manganese oxides, as well as pyromorphite and calamine, are not attacked even on boiling the solution. Cuprite is completely decomposed in the cold, with formation of a bright green crystalline precipitate ($CuIO_5$?). Brucite, calcite, and natrolite are decidedly attacked on boiling. Anglesite is feebly attacked in the cold, and strongly on heating; cerussite and vivianite appear to be slightly decomposed under the same circumstances. None of these reactions have special interest, except perhaps that of cuprite, which is quite characteristic.

Having continually in mind the possible application of methods to the examination of minerals in the field, and recognising the impracticability of carrying iodine save in glass bottles, we were led to make another series of experiments with a view to providing iodine in a portable state. To this end, we took advantage of the ready decomposition of potassium iodide by organic acids. That even the weakest acids are able to set hydriodic acid free, in acting on the iodides of the alkaline metals, has been frequently noticed,† and we add the following observations:—

When solid potassium iodide is added to strong acetic acid, in the cold, hydriodic acid is set free; and after standing for some time (24—48 hours), this acid decomposes, and the free iodine communicates to the solution a brownish-red colour of varying intensity. With free access of air, the liberation of iodine begins at once, as shown by testing the mixture with carbon disulphide. This action is more marked in strong solutions than in weak.

Tartaric and nitric acids decompose potassium iodide in a similar manner.

A mixture of any of these organic acids with potassium iodide proves to be a powerful solvent of the natural sulphides. An examination of the seventeen sulphides already mentioned gave the following results:—

Behaviour with Potassium Iodide and Citric Acid.

Stibnite, *argentite*, *sphalerite*, *chalcocite*, *bornite*, and *ullmannite* are attacked in the cold, with liberation of sulphuretted hydrogen; heat increases the action,—the gas coming off freely.

Galenite acts in the same manner, with formation of yellow crystalline flakes of plumbic iodide. On applying heat, the mineral is completely decomposed.

Cinnabar is also decomposed in the cold, with liberation of sulphuretted hydrogen. On boiling, the decomposition is complete, and crystals of mercuric iodide deposit on cooling, provided no great excess of potassium iodide is present.

Arsenopyrite is decomposed in the cold, but no sulphuretted hydrogen appears to be set free. On boiling, the decomposition proceeds rapidly.

Pyrrhotite, *chalcopyrite*, and *bournonite* yield no sulphuretted hydrogen in the cold, but freely on heating. The latter is but feebly attacked.

Pyrite, *niccolite*, and *smaltite* give no sulphuretted hydrogen, either cold or hot, though they are strongly attacked on boiling the liquid.

Tetrahedrite is attacked feebly in the cold; on heating, the action is increased.

Molybdenite resists the action of this mixture of reagents.

Similar results were observed with tartaric and oxalic acids, their decomposing power varying. Cinnabar, treated with a mixture of potassium iodide and oxalic acid, is decomposed with remarkable facility; the reaction sets in immediately and in the cold; on boiling, the decomposition continues with violence; and on cooling, the solution deposits white crystals of hydro-potassium oxalate, mixed with scarlet crystals of mercuric iodide.

The probable nature of this reaction is shown in the following equation:—

$$2H_2C_2O_4+HgS+2KI=2KHC_2O+H_2I_2+H_2S.$$

We examined the behaviour of a few additional minerals with a mixture of potassium iodide and citric acid, with the results recorded below; but no special interest seems to be attached to this method of attack.

Magnetite is decidedly, and *franklinite* feebly, attacked in the cold, and strongly on heating. *Hematite* is feebly attacked, and *chromite* not at all.

Hausmannite, *pyrolusite*, and the other oxides of manganese, being attacked by citric acid alone, yield, as may be anticipated, deep brown-red solutions coloured by the iodine.

Anglesite and pyromorphite are completely decomposed in the cold, with formation of a yellowish-white precipitate of plumbic iodide.

Cuprite is also completely decomposed in the cold, with formation of a yellowish-white precipitate of cuprous iodide, and a colourless solution. If, however, heat be applied at the outset, the same precipitate forms, while the solution is of a blue colour.

We also examined the behaviour of natural sulphides with a mixture of citric acid and potassium bromide. The latter does not, however, appear to be so easily decomposed as the iodide, and no characteristic phenomena were observed; nearly all the metallic bromides being soluble in water, no precipitates were obtained. In order to avoid repetition, we may briefly summarise the results by stating that, in general, the action of the bromide is less energetic than that of the iodide. Those minerals which yielded only with difficulty to the latter reagent resist the former even on heating. Cinnabar, whose behaviour with the iodide is so remarkable, is but feebly attacked by the bromide. Argentite, galenite, sphalerite, chalcocite, pyrrhotite, pyrite, and chalcopyrite, are attacked in the cold, with or without liberation of sulphuretted hydrogen. Molybdenite resists this mixture of reagents, as well as the others previously mentioned.

In studying the behaviour of minerals with organic acids, we obtained results which were embodied in a Table* exhibiting the eleven groups into which minerals are divided by the action of citric acid alone, and with reagents. We are now able to add a twelfth group, viz: "minerals decomposed by heating with citric acid and

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* On some Improvements in the Preparation of Hard Minerals for Analysis, read before the A. A. A. S., at the Baltimore meeting. *Am. J. Sci.*, [2], vol. xxvi., p. 190.

† Dr. Rudolph Bœhm, in his *Handbuch der Spec. Pathologie und Therapie*, vol. xv., p. 21, quotes Struve's discovery than even hydrosodium carbonate decomposes potassium iodide in dilute aqueous solution. This power of carbonic acid has also been observed by Kammerer (Virchow's *Achiv*, lix., 1874), and Binz (*ibid.*, lxii).

* *Ann. N. Y Acad. Sci.*, vol. i., p. 30.

potassium iodide," and to transfer thereto, from the list of "minerals not decomposed by the above reagents," four species—cinnabar, magnetite, hematite, franklinite.

Thus of the ninety minerals whose behaviour with organic acids and reagents has been examined, only nine resist these methods of attack.

Trinity College, Hartford, Conn.

LABORATORY NOTES FROM THE UNIVERSITY OF CINCINNATI.

By F. W. CLARKE, S.B., Professor of Chemistry.

On some Seleniocyanates.

In 1855 Buckton discovered and described the double sulphocyanates of platinum.* Of these the potassium salt is perhaps the one best known, partly because of its beauty, and partly because of the ease with which it may be prepared. Recently, my attention having been called to this compound, it occurred to me that it might be interesting to prepare the corresponding seleniocyanate. Accordingly I assigned the task to Mr. W. L. Dudley, a student in the University of Cincinnati, who had little difficulty in attaining to success.

When an alcoholic solution of potassium seleniocyanate is added to a similar solution of platinic chloride, a heavy reddish brown precipitate is immediately formed, This, upon boiling, becomes darker in colour, and apparently in part dissolves. The filtered liquid deposits crystals of new salt, mixed with a reddish sediment of selenium; and these, although they are slightly unstable, may be purified by re-crystallisation from alcohol. The crystals are usually very small, mere scales in fact; although on one occasion they separated out as regular six-sided tables, several millimetres in diameter. By reflected light they are nearly black, but by transmitted light deep garnet red. Specific gravity, 3·377 at 10·2°, 3·378 at 12·5°. The weighings were made in benzol. Determinations of platinum and potassium came out as follows:—

	Found.	Theory.
Potassium	8·57	8·61
Platinum	21·64	21·73

There is, therefore, no reasonable doubt that the new salt is represented by the formula $K_2Pt(CSeN)_6$, and that it is strictly analogous to Buckton's sulphocyanate.

An attempt to prepare gold salts resembling the sulphocyanates described by Cleve† was only partially successful. When alcoholic solutions of potassium seleniocyanate and neutral gold chloride are mixed, a red precipitate falls, which consists in large part of free selenium. The pale orange-yellow filtrate from this precipitate yields by spontaneous evaporation a crystalline crust, which, under the microscope, is seen to be made up chiefly of minute deep red prisms. These crystals are so very unstable that we could obtain but a very small quantity of them, and in a somewhat impure condition. They yielded 48·31 per cent of gold, whereas the salt $KAu(CSeN)_2$, analogous to the potassio-aurous sulphocyanate of Cleve, should contain but 43·94. As the new salt was prepared by a method precisely similar to that which gave Cleve his sulphocyanate, there can be little doubt that we had to deal with the corresponding seleniocyanate, mixed with free gold. If we had been able to command larger quantities of material, we might have been able to prepare the compound in a state more nearly approaching purity.

No seleniocyanate resembling Roesler's potassium chromo-sulphocyanate, $K_6Cr(CSN)_{12}8H_2O$,‡ could be obtained. When aqueous solutions of chrome alum and potassium seleniocyanate are mixed, selenium is precipitated, and no trace of any double salt seems to be formed.

* *Chem: Soc. Quart. Journ.*, vii., 22.
† *Jahresbericht*, 1865, p. 295.
‡ *Journ. für Prakt. Chem.*, cii., 316.

On the Electrolytic Estimation of Mercury.

In 1865 Wolcott Gibbs published his well-known method for the electrolytic estimation of copper.* More recently Merrick oas shown that a modification of the same process is applicable to nickel and to zinc.†

Having occasion recently to make a number of copper determinations by this method, it naturally occurred to me that it might be extended still farther, especially to the cases of cadmium and mercury. With cadmium I was disappointed, but with mercury successful. Cadmium may indeed be completely precipitated by electrolysis from an ammoniacal solution, but it comes down in a spongy porous form, enclosing various impurities which cannot be readily washed out. Accordingly the results came out several per cent too high. The mercury, however, gave results in every respect satisfactory.

A solution of mercuric chloride, slightly acidulated with sulphuric acid, was placed in a platinum dish connected with the zinc pole of a six-cell Bunsen's bichromate battery. The wire from the carbon pole terminated in a thin slip of platinum foil, which dipped into the solution. At first mercurous chloride was precipitated, but this by degrees was reduced to the metallic state, so that after an hour or so there remained in the dish a clean mass of mercury, covered by a solution in which ammonia failed to produce the slightest turbidity. When I poured off this clear acid solution the mercury became covered with a thin tarnished film, which at first annoyed me considerably. I soon found, however, that this annoyance could be avoided very easily. I simply drew off the solution from above the mercury by means of a pipette, and replaced it with clean water; doing this several times before disconnecting the platinum dish from the battery. Then, upon decanting the very feebly acid supernatant liquid, the metal remained perfectly bright and clean. It was only necessary after this to rinse thoroughly with pure water, then with alcohol, and lastly with ether, and to dry under the receiver of an air-pump. Two determinations made with mercuric chloride gave respectively 73·76 and 73·85 per cent of mercury. Theory, 73·80. There are no difficulties in the process, and no appreciable sources of error. Although I have made actual determinations of mercury only with chloride, I have tested other salts of the metal and have found that the precipitation is similarly perfect. In one instance I employed a solution of mercury containing a heavy precipitate of basic sulphate. This precipitate was readily and completely decomposed by the electric current, so that ultimately nothing but metallic mercury remained visible in the solution. In every case mercurous compounds appear to be thrown down first, so that their final disappearance furnishes a sharp end reaction to indicate when the operation is complete.—*Am. Journ. Science.*

* *Am. Journ, Sci.*, xxxix., 64.
† *Am. Chem.*, October, 1871; Chem. News, xxiv., 100, 172.

SYMBOLIC POINTS OR GRAPHIC RELATIONS BETWEEN THE ATOMIC WEIGHTS AND THE ATOMIC VOLUMES OF SIMPLE BODIES.

By A. F. NOGUES.

For some years the author has been occupied with an important problem in atomic physics "on crystallisation and on changes of structure induced by molecular movements." It is well known that iron is capable of crystallising when raised to a temperature sufficiently high to soften it. Platinum is also capable of crystallising by

molecular movements without previous liquefaction. This study of crystallisation of molecular movement has necessarily led the author to researches on the properties of solid bodies. He describes a graphic table formed by placing upon squared paper the atomic weights and atomic volumes upon the lines of the abscissæ and ordinates. He gives somes remarkable lines of symbolic points. In the first place the five metals, manganese, iron, nickel, copper, and cobalt, form a close and numerous group which may be called the group of the magnetic metals. If we then draw a straight line, passing by iron and very near manganese, and afterwards very near phosphorus and sulphur, the same series comprehends titanium and chrome. Another straight line through nickel and cobalt passes afterwards by zinc, tellurium, arsenic, and selenium. A straight line taken through manganese and iron passes by molybdenum, ruthenium, cadmium, osmium, and bismuth. There are therefore three remarkable linear series which intersect each other in a narrow space in the midst of the group of the five metals. But among these three we must distinguish the one which takes a mean direction between the two others (nickel, cobalt, zinc, tellurium, arsenic, selenium), and which is parallel to three other important linear series—the four parallel series are, in fact, composed of the following elements:—

1. Carbon, aluminium, sulphur (and phosphorus very near).
2. Nickel and cobalt, zinc, tellurium, arsenic, selenium (by the group of the magnetic metals).
3. Palladium, rhodium, cadmium, tin, antimony.
4. Platinum, gold, tungsten, iridium, mercury, lead, silver, bismuth (precious metals?).

Sulphur and phosphorus are situated very near the intersection of the oblique line passing by titanium and the magnetic metals. But the most remarkable is the line which connects the magnetic metals with bismuth: the precision with which it passes through manganese, iron, cadmium, and bismuth is very singular; further, this linear series is connected with that of the precious metals by bismuth, and with the palladium and antimony series by cadmium.

It is easy to comprehend the importance of this method of grouping simple substances, both for classification, for the study of certain special properties, and for detecting the analogies of the elements.—*Correspondance Scientifique.*

VERIFICATION OF GRADUATED GLASS VESSELS AND AREOMETERS FROM 4° to 45° C.*

By P. CASAMAJOR.

(Concluded from p. 158)

We may now proceed to eliminate the condition of weighing *in vacuo*, by considering that a body, placed in a medium, loses a weight equal to that of the medium displaced.

Therefore, if we subtract from the numbers of the second column the weight of 100 c.c. of air at the atmospheric pressure, and at the various temperatures from 4° to 45° C., we obtain quantities expressing the number of grms. of distilled water which, at the pressure of the atmosphere, would occupy a space in a glass vessel which at 15° is equal to 100 c.c. We have done this for the pressure equal to 760 millimetres of mercury, the normal pressure of the atmosphere. At this pressure, and at 0° C., 100 c.c. of air weigh 0·1293 grm., and we might take this weight as the base of our calculations; but we may take into account the weight of air displaced by the brass weights, placed on the other pan of the balance, which is to be subtracted. As all the larger weights used by chemists are made of brass, where specific gravity is 8, we should take seven-eighths of 0·1293 = 0·1132 grm., which is the difference of the weight of air displaced at 0° C. by 100 c.c. of water, and by the corresponding brass weights.

The expansion of air for every degree Centigrade is equal to 0·00366, and, therefore, the weight of air, which at every degree of temperature occupies the same volume as 0·1132 grm. at 0° is—

$$\frac{0{\cdot}1132}{1+0{\cdot}00366\ t},$$

t being the degree Centigrade.

By subtracting the numbers thus obtained from those of the second column of Table No. 2, we obtain in a third column the number of grammes of distilled water, which at the normal pressure of the atmosphere and for every degree from 4° to 45° C., we are to weigh, so as to fill up a volume in a glass vessel, which at 15° is equal to 100 c.c.*

In conclusion of this first part, which relates to graduated measuring-vessels, I propose to repeat what I have said on a previous occasion (*Proceedings of A. C. S.*, vol. i., second part, p. 23, foot-note), to show the accuracy of the numbers in Table No. 1. I do this because, if I have been successful in explaining what I had to say, you must be satisfied that if Table No. 1 is correct Table No. 2 is equally so.

A long time before calculating Table No. 1, I found directly by experiment (*American Chemist*, June, 1874, p. 449) that the total relative expansion of water from 5° to 45° C. was 0·00021. Now, if we calculate this same quantity from Table No. I, by adding the total contraction at 5° (0·000612) to the total expansion at 45° (0·008312), the sum 0·008924, divided by 40, will give 0·000223, which is as near 0·000210 as could be expected, if we remember that the extreme numbers, 0·000612 and 0·008312, contain the accumulated errors of this table.†

Verification of Areometers.

The areometer whose correctness we have to verify may either indicate specific gravities, or its scale is one whose divisions are equal to one another. In the latter case, the specific gravity corresponding to any division of the scale may be found by the formulæ which were given in the paper "On Areometers," which I had the honour of reading before this Society in the month of April of last year.

In these formulæ N is the total number of degrees of even scale, d a degree of this scale, and P the corresponding specific gravity. We have—

$$N=\frac{Pd}{P-1}$$

$$P=\frac{N}{N-d}$$

$$d=N-\frac{N}{P}.$$

If, for instance, we take for the specific gravity of sulphuric acid, H_2SO_4, the number 1·845, found by Dr. Ure, and use Beaumé's areometer, in which this specific gravity corresponds to 66°, we have—

$$N=\frac{1{\cdot}845\times 66}{0{\cdot}845}=144{\cdot}02,$$

which is as near as possible the generally accepted standard for Beaumé's areometer in Germany and in this country, in which N = 144. As, however, graduation of even scale can never be anything but a conventional matter, any other number, N, founded on any other specific gravity, as determined by any other chemist, would be equally

* Read before the American Chemical Society, July 11, 1878.

* As the capacity equal to 100 c.c. at 15° in a glass vessel varies with the temperature, a further correction might be made for this variation, but it is so insignificant as not to affect the fourth decimal at 45° C.

† The table of Dr. Hermann Kopp agrees still more closely with the result I found; it gives for the mean expansion for 1°, between 4° and 45° C., 0·000209. (See *American Chemist*, June, 1874, p. 449.)

good, provided this other number, N, was generally accepted.

In the paper to which I have referred mention was made several times of the verification of areometers by ascertaining the corresponding specific gravity by the balance; but I did not enter into any details as to the manner of taking these specific gravities. I propose to do this now, as the subject is one of great importance, and more open to misunderstandings than I had supposed.

We must, in the first place, recal the definition of the specific gravity of a liquid, which is—*the quotient obtained by dividing the weight of a certain volume of the liquid by the weight of the same volume of water, both weights being taken at the same temperature and the same pressure.*

If our measuring vessels retained a constant volume at all temperatures, and if the dilatation of all liquids was the same for equal variations of temperature, the specific gravity of a liquid, which is its weight compared with that of water, under the same volume, would be the same at all temperatures. If at 4°, and *in vacuo*, 100 c.c. of a liquid, whose specific gravity is 1·5, weigh 150 grammes, at 25°, and *in vacuo*, the weight of 100 c.c. of water being—

$$\frac{1}{1{\cdot}003067} = 99{\cdot}69 \text{ grammes},$$

the weight of 100 c.c. of the liquid in question would be $99{\cdot}69 \times 1{\cdot}5 = 149{\cdot}535$ grammes.

As the volumes of glass vessels increase by heat, and as the expansions of liquids are different for the same variation of temperature, it is customary in areometers, as in measuring vessels, to specify that the graduations are taken at a certain temperature, which is generally 15° C.

For the purpose of testing areometers, and, in general, for taking the specific gravities of liquids at 15°, it is very convenient to have a glass flask, which, at 15° and at the pressure of the atmosphere, holds 100 grammes of distilled water up to a line on its neck. Then the number of grammes gives directly the specific gravity, at 15°, of any liquid, occupying the same space, without further calculation.

Now, I wish to call to your attention, that, if we have a flask graduated in this manner, we may, at any temperature, obtain indications to verify the scales of areometers.

If the temperature of the liquid is different from 15°, and the areometer marks 1·5 specific gravity, the indication is not correct on account of the variation of the volume of the liquid and of the areometer. But if we keep the liquid at the same temperature, and place it in the flask, so as to fill the volume, which, at 15°, holds 100 grammes of water, and we find that the weight of the liquid is 150 grammes, we may conclude that the areometer which showed 1·5 sp. gr. was correct.

The reason for this conclusion is, that, although both indications are incorrect, the error depends on the expansion of glass and the expansion of the liquid, and these are exactly the same in both cases; therefore, if these errors were eliminated, the equality would still persist.

To express this preposition algebraically, suppose that a and b are the indications that we would have at 15° with the areometer and the flask respectively, and that x and y are the errors in each case from operating at a temperature different from 15°. If $a+x=b+y$, and if at the same time $x=y$, then $a=b$.

CORRESPONDENCE.

HISTORY AND WORKING OF THE ALKALI ACTS OF 1863 AND 1874.

To the Editor of the Chemical News.

Sir,—In your article on the above subject in the Chemical News of 27th instant, you mention my name as objecting to the clause of the 1874 Act which fixes the limit of escape at one-fifth of a grain of hydrochloric acid, and continue—"Mr. Mactear seems, however, to be alone in this opinion, and it seems to be pretty generally agreed amongst other manufacturers that the new mode of testing is superior to that in the original Act."

The Report of the Commissioners on Noxious Vapours does not give the evidence in full, and while you are justified in your statement by the extract in the report, I trust you will afford me the opportunity of saying that my opinion, as given in evidence before the Commission, is quite *contrary* to that ascribed to me, as you will see from the following extract from the printed evidence I prepared and laid before the Commission.

"Am of opinion that the Act of 1874 bears very unequally on manufacturers, and more heavily in many cases on those who are most anxious to condense well, and who have spent large sums for what, in many cases, is little more than an idea.

Does not object to inspection—on the contrary, would be much pleased to see it largely extended and made more efficient. A large amount of the Inspector's work has at present to be done by the manufacturer. Witness's firm employs five chemists and two lads at their various works, constantly testing the escapes. Without this constant testing it would be impossible to keep the escape down to the 0·2 gr. per cube foot limit. Submits note of testings, which will show amount of work required.

There is an idea that the Act of 1874 reduced the escapes from 5 per cent to 2·5 per cent. This is an utter mistake. In a few works like our own, and those of Messrs. Chance, of Oldbury, the total escape has been reduced, but in many works it has actually increased.

I approve highly of the fixing a limit in the chimney, as being a simple and convenient means of getting at the escapes, but, as at present carried out, the honest manufacturer is at the greatest disadvantage.

Notwithstanding that our condensation is fully 99 per cent, it is quite impossible to keep our chimney escape down to 0·2 gr. per cube foot without what I consider to be a distinct evasion of the spirit of the Act, viz., diluting the gases with air.

This diluting the gases with air I object to most strongly, for many reasons, of which—

1st. It renders it much more difficult to attain accurate tests of the escape.
2nd. It necessitates the consumpt of more coal to heat this air up to the average chimney temperature; and
3rd. This extra coal increases the evil the air is to cure by giving off sulphur acids nearly equal to the reduction in HCl.

Take, for instance, two works of the same capacity and class, decomposing the same amount of salt, and consuming the same amount of fuel, working in exactly the same way:

No. 1	No. 2
Has only *one* chimney into which all the gases escaping from the works pass.	Has *ten* chimneys, into only *one* of which the escape of HCl passes.

It can at once be seen that on the present principle o rating escapes per cube foot, the No. 2 works are placed at an enormous disadvantage, as it is quite possible for the No. 1 works to send out nearly *ten* times more *weight* of HCl and yet comply with the required limit of 1874.

As a matter of fairness to those manufacturers who are anxious to do well, the escape ought to be taken on the total chimney gases; and I do not think there would then be a single work that could not honestly comply with the limit, because I know of cases where 15 per cent. of the HCl has been escaping, and yet the test of the chimney was not over 0·2 grain per cube foot.

Have spent very large sums of money in alterations and repairs, and would willingly do more if we could see what would be of benefit.

Feel aggrieved that after the expenditure of large sums of money and a large amount of time and attention, are not rated as being better than those who may be sending out the full 5 per cent.

No allowance is made for height of chimneys, as causing dilution, and if dilution is to be the measure surely this should be considered, as it has been seen from the case of coke ovens that the erection of a higher chimney has reduced the damage very much indeed.

No more stringent limit per cube foot could be complied with by us.

Would not object to a reduced limit of percentage, but think the Act of 1874 quite sufficient, if carried out, to prevent nuisance.

Think increased inspection urgently required, and inspectors of a high class necessary; also, that all works should be brought up to the standard of the best works of the present day before further legislation takes place. It is notorious that some works are very badly conducted, and undeniably do a great amount of damage.*

A lower limit of escape per cube foot might be borne if taken on the total gases escaping from the works.

In these works the escape taken at the extreme limit of 0·2 in the chimney containing HCl is only equal to 0·023 on total chimney gas, as they would be if led into one chimney, which is quite impossible, owing to the large extent of ground covered by the works."

To illustrate further my ideas, suppose, for instance, that instead of using one tall chimney for all my salt-cake furnaces, I were to erect a small chimney of say 30 or 40 feet high *for each furnace*, I would have little difficulty in keeping them all down to the limit of one-fifth of a grain, even when sending out a much greater weight of hydrochloric acid than before, at a much lower level. It does not require much consideration to show that while this might comply with the requirements of the Act of 1874, it would enormously increase the cause of complaint, besides increasing the inspection (to, in my case, some 25 times more than is at present required.—I am, &c.,

JAMES MACTEAR.

St, Rollox, Glasgow,
September 30th, 1878.

SUNDRY NOTES.

To the Editor of the Chemical News.

SIR,—The article in your journal for August 30, by Dr. Phipson, upon a new mineral white pigment, leads me to say that eighteen months, and one year ago, I did a great deal of work upon this pigment. My experiments were made upon ounces, pounds, and tons, and I can confirm what is said about its excellent qualities, with one exception. It was only by accident that I succeeded in getting it *pure whites*. There would be, in nine cases out of ten, a faint yellow tint, sometimes more marked than at others; but too often visible enough to hurt the paint for the market. Oxide of zinc, made by combustion, becomes yellow on heating, and recovering its whiteness on cooling. The precipitated oxide, after having been heated, never becomes, I believe, fully white,

The beauty, covering property, and other excellent qualities of the paint, are all your correspondent asserts.

The editorial remarks in the same number under book notices, in regard to the neglect of inorganic chemistry, are very refreshing. It is melancholy to take up the journals and the *Jahresbericht*, and find them full of pictures of the position of atoms of carbon in dinitrodiphenylen-methan, and similar bodies, side by side with guesses about the probable constitution of some complex, useless, and needless organic substance, while important practical matters in inorganic chemistry are calling aloud for investigation—*e.g.*, there is abundant opportunity for research in making a comparison of the chlorides of iron and metal, in investigating the change of colour in zinc oxide under heat, in working out the metallurgy of cobalt, and in solving hundreds of practical and trying questions in the chemistry of the metals.

I am not sorry to see you have a word to say against the pretty pictures of molecules of bodies in Dr. Frankland's book. Nobody, I suppose, can disprove the accuracy of the pictures, but I never was able to derive, as student or lecturer, much, if any help, from these ingenious puzzles.

Frankland himself sees the danger "that students will regard them (the diagrams) as representations of the actual physical position of atoms." Such a regarding is not only likely, but inevitable.

I have been in hopes that my notes in June and July numbers of the CHEMICAL NEWS upon the absorption of sugar by bone charcoal would bring out some replies or cause some discussion. Perhaps the question is regarded as thoroughly settled, and that I am engaged in re-slaying the slain. Here, in spite of the evidence, the question is in some sense, an open one. For my part I regard the fact of the absorption of sugar by animal charcoal as well confirmed as the insolubility of sulphate of baryta in water.—I am, &c.,

J. M. MERRICK.

Laboratory, 59, Broad Street, Boston, U.S.A.,
September 14th, 1878.

* Compare Dr. Smith's figures for escape of Sulphur Acids from Vitriol Chambers (Eighth Annual Alkali Inspector's Report for 1871), where escapes vary from under 1 per cent. to 27 per cent,

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 12, September 16, 1878.

New Telephonic Transmitter.—P. Dumont.—This system, which has given the author results superior to those of any other apparatus of a similar kind which he has been able to try, is a combination of the pack-thread telephone and of the electric charcoal microphone. A parchment membrane of 12 centimetres in diameter is stretched over a vertical frame. In its centre is fixed a thread secured by a knot on one side, and which taking, on the other side, at first a horizontal direction, passes round a small pulley and supports at its other extremity a small cone of brass suspended by a hook fixed to the centre of its base. This piece, which is relatively speaking tolerably heavy, plunges its point to the depth of about 1 millimetre into a metallic cube full of powdered gas-coke, and fixed upon the horizontal plate, which, forming the foot of the apparatus, supports the stem of the frame fitted with the diaphragm. One of the poles of the battery (a Leclanché of four elements) is connected with the metallic cone, and the other with the cube containing the coke-dust. The slightest vibrations imparted to the membrane by sound-waves suffice to modify the pressure of the cone in the coke-dust, thus determining variations in the intensity of the current.

Process Proposed for Effecting the Analysis of Milk.—E. Marchand.—Referring to the paper presented by M. Adam the author points out that as far back as 1854 he proposed a new method of determining the butter in milk by treatment with ether and alcohol in presence of a couple of drops of caustic soda. In the hands of M. Adam the method has lost in simplicity without gaining in exactitude.

Chemiker Zeitung.
No. 36, September 5, 1878.

At Mantua, on July 25, during a violent shower, some children in the Piazza Virgiliana thought that hail was falling. The supposed hail-stones were pieces of salt, some of which are in the hands of the Director of the Observatory, Prof. Agostini.

Cupriferous Food.—Holdermann found in the ashes of six middle-sized cucumbers which had acquired a brilliant green colour by being moistened with vinegar, placed in a copper vessel, and exposed to the air (a favourite process with cooks), not less than 0·045 grm. cupric oxide. Four such cucumbers would contain copper equal to the maximum dose of the German Pharmacopœia.—*Archiv. Pharm.*, x., 98.

Determination of Manganese as Pyrophosphate.—Munroe determines manganese as pyrophosphate similarly to magnesia. The solution of a manganic salt is boiled for five minutes in the water-bath with an excess of sodic pyrophosphate; the precipitate is dissolved in a minimum of hydrochloric acid, and then boiled for fifteen minutes with ammonia, avoiding excess. The precipitate is redissolved in hydrochloric acid, re-precipitated with ammonia, and the white crystalline precipitate, which turns partially brown on exposure to the air, is boiled for more than an hour. Mere traces of manganese remain in the filtrate. An excess of ammonia makes the result inaccurate. The precipitate is treated exactly like the corresponding magnesian precipitate.—*Archiv. Pharm.*, x., 165.

New Method of Detecting Arsenic.—The substance in question is mixed with a little water, or its solution is poured into a small beaker, and a piece of sodium amalgam as large as a grain of wheat is introduced. The beaker is then covered as rapidly as possible with a piece of white filter-paper or a porcelain lid, previously moistened with a weak feebly acid solution of silver nitrate. The presence of arsenic is indicated by a blackening of the paper or of the porcelain. As antimony hydride is not given off—or in mere traces—from strongly alkaline liquids, the solution should be rendered distinctly alkaline. In this manner the confusion of antimony and arsenic is rendered improbable, though not quite excluded. Organic matter does not interfere.—*Archiv. Pharm.*, x., 170; *American Journal of Pharmacy*, vii., 126.

Determination of Alcohol in Wine.—The liquid is agitated with a mixture of 4 vols. amylic alcohol and 1 vol. of washed ether, and the proportion of alcohol is calculated from the decrease in volume, according to a table based upon experiment.—*Arch. Pharm.*, x., 176.

Volumetric Determination of Phenol.—Degener employs the reaction of phenol and bromine, both in aqueous solution. From 10 to 30 c.c. of the liquid to be tested, which must be free from SO_2, are titrated with solution of bromine. As soon as all the phenol has been deposited as snow-white flocculent-curdy tri-brom-phenol, the supernatant liquid, especially if seen against a pale blue surface, appears of a distinct yellow colour. The value of the bromine solution must be re-determined before every operation.—*Journ. Prakt. Chemie*, xvii., 390.

Hydrogen peroxide is formed, according to Prof. Bœttger, on the explosion of oxyhydrogen gas. Its presence may be shown by exploding the gaseous mixture in a glass containing ¼ litre, and adding immediately a few c.c. of starchy cadmic iodide solution, and a few crystalline fragments of sulphate of iron and ammonia. On agitation a deep blue colour shows the presence of hydrogen peroxide.—*Polyt. Notizblatt*, xxxiii., 233.

Adulteration of Straw.—According to Stromayer, "straw-stuff" for paper makers is weighted with sulphate of magnesia.—*Industrie-bl.*, xv., 318.

No. 37, Sept. 12, 1878.

Prof. A. Fischer, of Prag, has been poisoned by a mixture of cyanide of potassium and sal-ammoniac, whilst experimenting on the means of rendering the former salt innocuous.

An important bed of guano, 8 miles in length, by a breadth of from 50 to 500 metres, and a depth of 1½, has been discovered at Huata Bay, in Peru.

No. 38, Sept. 19, 1878.

Meeting of the German Sanitary Union at Dresden.—Prof. Neubauer, of Wiesbaden, read a paper on the "Treatment of Wines from a Hygienic Point of View," and laid down the following propositions. The name of wine belongs exclusively to the beverage formed by the fermentation of the juice of grapes. Sulphuring with sulphur free from arsenic is permissible. As regards the admissibility of the bisulphite of lime, which, in animals, produces severe intestinal catarrh, further experiments are needed. The addition of chemically pure sugar to the must is allowable. The addition of alcohol can scarcely be prohibited if kept within certain limits, and if no amylic compounds are introduced. The neutralisation of the acids in wines by means of the salts of lime, magnesia, and potash can only be allowed within very narrow limits. "Plastering" can only be permitted if the amount does not exceed a certain legalised limit, in France 2 grms. per litre! (Why permit it at all?) Our knowledge concerning the physiological action of glycerin and salicylic acid does not justify their absolute prohibition, especially as the former is a normal constituent of natural wines to the extent of 6 to 8 grms. per litre. The addition of alum or of sulphuric acid is to be prohibited as pernicious. The artificial production of red wines from white wines, by the addition of tannin and extraneous colouring-matters is to be prohibited. All alcoholised or sweetened wines, and all artificial wines, are to be sold only under names which can lead to no misunderstanding as to their nature. (We may be permitted to remark that these principles here laid down assuredly do not err on the side of severity. To forbid such innocent additions as the juice of cherries and bilberries, and yet tolerate gypsum to the alarming extent above mentioned, seems also scarcely consistent.)

Prof. Hofmann read a paper on the "Food of Children." He suggested the establishment of dairies under medical supervision, and proposed that, on all packets, &c., of prepared foods, the chemical composition should be expressed, so as to show the proportions of water, albumen, fats, soluble and insoluble carbohydrates, and the salts most important for nutrition.

Detection of Extraneous Starch in Chocolate.—Dr. Wittstein.—The aqueous decoction of pure chocolate gives no reaction with iodine, whilst the contrary is the case if starch or the meal of any cereal has been added.

Justus Liebig's Annalen der Chemie,
Band 193, Heft 3.

Experimental Researches on Hydrogen Peroxide.—Em. Schœne.

Behaviour of Hydrogen Peroxide with the Alkalies.—(Second Treatise).—The author concludes that the "catalysis" of hydrogen peroxide in alkaline solutions is essentially dependent on (1) the property of the alkalies to form compounds of the composition $R_2H_4O_6$, or $R_2O_2.2H_2O_2$; (2) the tendency of the alkaline metal to become more highly oxidised within this compound, namely, to tetroxide; (3) by the reduction to dioxide, under the influence of the water. That potassa effects the decomposition of hydrogen peroxide more rapidly than soda is explained by the fact that the disposition of potassium to form a tetroxide is greater than that of sodium.

Communications from the Laboratory of the University of Würzburg.—These consist of a paper by Dr. M. Conrad and W. R. Hodgkinson, on the synthesis of phenylated acids of the fatty series.

Chemical Composition of Yeast.—Prof. C. Nägeli and Dr. O. Loew.—"Bottom yeast" has the following chemical composition :—

Cellulose with vegetable mucus	37
Proteinic matters:—	
a. ordinary albumen	36
b. unstable compound resembling gluten and casein	9
Peptones precipitable by acetate of lead ..	2
Fat	5
Ash	7
Extractive matters, &c.	4
	100

The last mentioned item includes a peptonoid body and small quantities of invertin, leucin, and glucose, and still smaller traces of glycerin, succinic acid, cholesterinl guanin, xanthin, sarkin, and probably inosit, and traces of alcohol.

Communications from the Chemical Laboratory of the University of Kasan.—These comprise a paper on the conversion of diethyl-carbinol into methyl-propyl carbinol, with the synthesis and properties of diethyl- and methyl-propyl-acetic acid, by Alex. Saytzeff, and a memoir, by P. and A. Saytzeff, on diallyl-propyl-carbinol.

On Nitro-butylen. — L. Haitinger. — Nitro-butylen, $C_4H_7NO_2$, is a faintly yellow oil of extremely pungent odour and burning taste, heavier than water, and almost insoluble. It boils at 150°—158°, with slight decomposition, but can be distilled unchanged in a partial vacuum. The author has examined its reduction, its behaviour with water, with caustic soda, bromine, and hydrochloric acid. He sums up his results as follows: nitro-butylen is formed by the action of nitric acid upon trimethyl-carbinol or isobutylen. With reducing agents it yields ammonia; with water, aceton and nitro-methan: and with alcoholic soda, sodium nitro-butylen. It is capable of taking up two atoms of bromine.

Biedermann's Central-blatt,
June 6, 1878.

Thermo-conductibility of Bad Conductors, especially Rocks and Wood.—Dr. E. A. Less.—In stones, density and compactness greatly promote the conduction of heat, but other properties have also an influence. Stones of a crystalline texture conduct better than amorphous mechanical mixtures, and those with fine granulations better than such as are coarse. Definite laws can scarcely be as yet laid down. The observations made upon wood proves that it conducts heat much better in the plane of the fibres than in a vertical direction.

The Fertility of Volcanic Soils.—Prof. M. Truchot. —The author points out the remarkable richness of soils formed from the decomposition of lava as compared with granitic and trachytic earth. In these three classes of soils the phosphoric acid occurs in the respective proportions of 1 : 4 : 26. He doubts the influence of potash in determining the fertility of a soil, since it is more abundant in the trachytes than in the lavas.

Phosphorite Beds of Estremadura.—Drs. Egozene and L. Mallada.—The principal of these deposits at Lagrosan was discovered by Bowles at the end of the last century, but was neglected till between the years 1840 and 1850. The phosphatic minerals have been raised in a very unscientific manner, and the expense of transport is often so great that a ton of phosphorite, which at the mines can be bought for 12s., costs in England upwards of £3. The phosphitic deposits occur in a triangular space of 16,800 square kilometres, and are found in granite in the Cambrian slates, or in the Devonian transition limestones.

Manurial Experiments with Potash Compounds. —Dr. W. Engling.—The author finds that on calcareous soils containing abundance of silicate of potash, a dressing with common salt may partially be substituted for potash. The most advantageous potassic manure for feeding-beets is chloride of potassium applied immediately on the melting of the snow.

Peruvian Guano and Ammoniacal Superphosphate with reference to the Quality of the Crop.—Dr. W. Engling.—In every experiment Peruvian guano produced a greater proportion of digestible matter.

On certain Fungoid Diseases of Vines, and on their Treatment.—MM. Pfau, Schellenberg, Schnetzler, Farlow, Macagno, Garcin, and Schmitt.—"Le blanc" is the French name of a vine disease which, in its outward appearance, much resembles the symptoms produced by the phylloxera, though differing totally in its cause. Some of the authors above mentioned ascribe the disease to deficient drainage, others suppose the fungi are transferred to the roots of the vine from the mouldering stakes which are made chiefly of the wood of coniferous trees. It is recommended that these should be coated with tar. As a remedy for Oidium, Schmitt recommends a solution of 3 grms. copperas in a litre of water. In the early stages of the disease 2 grms. suffice.

Archives Neerlandaises.
Tome xiii., 2me Livraison.

A Pancratic Telescope, by F. C. Donders.—The ordinary Dutch or Galilean telescope has for its focal distance $F=\infty$, a constant length, and a constant magnifying power. The author seeks to construct a telescope, with which we may obtain, by the displacement of the lenses within certain limits, all magnifying powers in a continuous series.

Theory of the Pancratic Telescope of M. Donders. —J. A. C. Oudemans.—This paper consists almost exclusively of mathematical formulæ.

On Telescopes of Variable Magnifying Power.— J. Bosscha.—The author points out a defect in the telescope of Donders, and proposes an improvement.

Determination of the Focal Distances of Lenses of Short Focus.—J. A. C. Oudemanns.—Incapable of useful abstraction.

Synthesis of Bromated Ethylic Ethers.—Fr. Kessel. —Only two tetra bromethans are known with certainty, as theory demands.

Tome xiii., 3me Livraison.

Intensity of the Electric Currents of Bell's Telephone.—In a circuit of two connected telephones presenting together a resistance of 70 Siemens's units, or $58{\cdot}10^{10}$ Weber's units, the quantity of electricity circulating, in consequence of the oscillation of the plate $=0{\cdot}000000091$ electro-magnetic unities. This quantity could only decompose 8½ 10-millionths of a microgramme (0·001 milligrm.) of water. A sound of 880 simple vibrations, which would communicate to the plate vibrations of a micron of amplitude, would produce in the circuit currents whose mean intensity $=0{\cdot}0000792$.

Albumen of the Serum and that of Egg, and on their Combinations.—A. Heynsius.—The alkaline albuminates differ according to the degree of concentration of the alkali employed. Weak alkalies give rise to a combination which does not yield in solubility to paraglobulin. The acid albumens differ equally according to the energy and degree of concentration of the acid. M. Aronstein had about the same time arrived at the following results:—"that by dialysis, albumen can be obtained free from salts; that the albumen, both of blood and of eggs, is soluble in water, and does not coagulate on boiling, even after the addition of an acid; that the coagulation of these two species of albumen under the influen of heat is due to the presence of foreign salts." Th

results are diametrically opposite to those of the author. He concludes that Aronstein and Schmidt regarded their dialysed albuminous solutions as free from salts, because they incinerated too small quantities of matter; that their solutions remained limpid on heating, because they still contained alkali, and that they did not obtain coagulation after the addition of an acid, because such acid was used in excess. He finds that after the most complete dialysis, there is obtained a combination of albumen with phosphate of lime and magnesia, which is soluble in water, but a really neutral solution of which abandons albumen in a coagulated form at the boiling temperature, that it is not possible to obtain by dialysis albumen free fom salts, and that we are not justified in pronouncing it a compound soluble in water.

Moniteur Scientifique, Quesneville,
September, 1878.

Analysis of Wines: Detection of Plastering.—H. Marty.—The author undertakes to answer the questions how plastered wines are to be recognised, and up to what limit can it be affirmed that a wine has been plastered or mixed with a plastered wine? The determination of the sulphuric acid and of the tartar offers the only answer. Plastering largely increases the quantity of sulphuric acid normally present in all wines in the state of alkaline or alkaline-earthy sulphates. This augmentation may proceed either from direct plastering in the vat, which when carried to its maximum coincides with the total disappearance of the tartar, or by simple adulteration with a plastered wine. The increase of sulphuric acid is then less considerable, and the tartar is merely reduced. The determination of tartar being a very delicate affair in plastered wines it is preferable to examine the sulphuric acid, the determination of which suffices in most cases for the recognition of plastering. According to numerous analyses made the proportion of sulphuric acid normally present in a pure wine per litre ranges from 0·109 to 0·328 grm. of monohydrated acid, or 0·194 to 0·583 grm. neutral sulphate of potash. If the proportion falls below these figures we may pronounce that the wine has not been plastered, though it may still have been mixed with a small quantity of a plastered wine. But if these limits are exceeded plaster is certainly present. The following volumetric process is recommended for the rapid detection of plastering. A standard liquid is made up with 14 grms. of pure crystalline chloride of barium, 50 grms. pure concentrated hydrochloric acid, and distilled water enough to make up 1 litre. To 50 c.c. of wine raised to a boil are added 3 c.c. of the standard solution just mentioned. It is thrown upon a filter, and the filtrate is tested with a further addition of the barytic solution. If the mixture remains limpid the wine may be considered natural, but if further turbidity arises we have to do with a plastered wine, or at least with a mixture containing plastered wine. Next we take 50 c.c. of wine as before, heat to a boil, and add 10 c.c. of the standard barytic liquid. If the filtrate is rendered again turbid by a further addition of barytic solution the wine contains more than 2 grms. sulphate of potash per litre.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 56, August, 1878.

Report Presented by M. P. Schützenberger on a Memoir by M. C. Vincent on the Manufacture of Chloride of Methyl.—This paper will be inserted *in extenso*.

La Lancette Belge. No. 27, September 1, 1878.

The Yellow Fever at Savannah.—J. C. Le Hardy, M.D.—The author considers it demonstrated that in the dejections of the patients and in the dust floating in the atmosphere there exist minute fungoid plants not previously described, and which he seems to consider as the propagators of the disease. These plants require a temperature of 26·6° for their growth.

The Mosquito as a Vehicle of Disease.—The mosquito is found to be the medium for transferring *Filaria sanguinolenta* from the blood of one person to that of another.

MISCELLANEOUS.

Russian Scientific News.—M. Kazanoff has made several experiments on gold amalgams. It was fou that apparently fluid gold amalgams, containing different quantities of gold at ordinary temperatures, on being squeezed through thin leather bags, give as filtrates amalgams containing the same amount of gold; during these experiments amalgams of different concentrations gave filtrates containing 0·126 per cent of gold. These facts show that amalgams filtered through thin leather are similar to solutions of solids in water, the concentration of which chiefly depends on the temperature of the solution.

M. Letny, by passing naphtha residues through an ignited tube filled with charcoal, has obtained, besides gaseous products, also tar which was found to contain benzol, toluol, xylol, cumol, and a small quantity of amylene, hexylene, heptylene, and naphthalin. The specific gravity of the gas is 1·157; it consists of 53 per cent of ethylen, and of its homologous series, of acetylen and crotonyien. Tar obtained by the distillation of brown coal (lignite), when passed through an ignited tube with charcoal, is decomposed in a similar manner. M. Danilevsky found that protalbin obtained from albumen by the action of caustic potash without employing heat differs from albumen by its solubility in alcohol. On being heated with alcohol in a sealed tube, and next cooled protalbin is transformed into albumin.

SERGIUS KERN, M.E.

St. Petersburg.

TO TAR DISTILLERS AND OTHERS.

The Directors of The Gas Light and Coke Company require the services of a duly qualified person as manager of their Tar Works at Beckton, under the supervision of the Resident Engineer of the Station.

He must possess a knowledge of Chemistry and be thoroughly acquainted with all the details of the distillation of Tar, and also be able, if required, to design and superintend any addition to the Works which may become necessary.

Salary, £500 per annum.

Applications in writing accompanied by Testimonials, stating age and experience, should be addressed to me on or before Thursday, the 10th October.

(By order)
JOHN ORWELL PHILLIPS,
Secretary.

Chief Office,
Horseferry Road, Westminster,
September 20, 1878.

Wanted, a Young Man as Chemist. He must be intimately acquainted with fatty and Hydrocarbon oils, and have some commercial knowledge: applicants to state salary expected.—Apply to H. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, CHROME ALUM.—Apply, with Price and Sample, to Higgin, Lloyd, and Co., Little Peter St., Manchester

VITRIOL.—Advertiser (Tyne) desires an Engagement as Working Manager of Vitriol Plant. Knowledge of Manures. Best Tyne references.—Address, Vitriol, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Pure SULPHOCYANIDE of AMMONIUM, also Prussian Blue, For Sale.—Particulars from T. H. Woodman Dockhead Place, London, S.E.

SUPPLEMENT TO THE CHEMICAL NEWS.

No. 984.—OCTOBER 4, 1878.

CORRESPONDENCE.

CYANOGEN COMPOUNDS IN ALKALI MAKING.

To the Editor of the Chemical News.

SIR,—Mr. Mactear's letter in to-day's CHEMICAL NEWS (vol. xxxviii., p. 162) would make it appear that I had contested the statement made in his first communication to you on this subject (CHEM. NEWS, vol. xxxviii., p. 130), that "The formation of the cyanogen compounds takes place towards the end of the balling operation, when a high temperature of the mass prevails." I certainly did not contest that statement. If that statement were not true, the Pechiney process would be impossible.

What I did contest I think will have been plain to most of your readers. To Mr. Mactear's opinion that the formation of cyanogen compounds in the black-ash furnace can be avoided by avoiding the exposure of the mass, at the end of the reaction, to a high temperature, I opposed six facts. Mr. Mactear says that these facts do not disprove—his "statement" above quoted. They do not disprove that statement. They were not cited to disprove it, and have no bearing on it whatever. But they have some bearing on Mr. Mactear's doctrine as to the conditions of the formation of cyanogen compounds in the black-ash furnace. How far, if at all, his criticism of them lessens their force against that doctrine I am content to leave your readers to judge for themselves.

"The cyanogen compounds," Mr. Mactear now declares, "are not formed from the nitrogen of the mixing coal, . . . but are produced by the action of the highly heated nitrogen in the gases of combustion from the fuel upon the alkalised carbon in the mass in the furnace." No fact is given in support of this assertion. Allow me to give a fact on the other side.

Some years ago, the manager of a German alkali work, from a visit to which I have just returned, was using an exceptionally nitrogenous mixing coal, and his black-ash was exceptionally rich in cyanides. He was then making ash from fished salts, and caustic from the red liquors. The red liquors were so rich in cyanogen compounds that it was found advantageous to cool those liquors and allow the cyanogen compounds to crystallise out. This paid so well that endeavours were made to *increase* the already exceptional proportion of cyanides in the black-ash. Exposing the finished black-ash for a longer period, with constant working, to the action of furnace gases was not found to do this to any perceptible degree; but adding to the finished black-ash a further quantity of very nitrogenous coal was found to augment the proportion of cyanides in the black-ash to very nearly the full extent of the nitrogen in the coal so added. This experience led to a search for the most nitrogenous coal that could be obtained, and it was found advantageous to fetch such coal from a very considerable distance. This method of obtaining, unquestionably from "the nitrogen of the mixing coal," cyanogen compounds for sale as such was very profitable for some years, and was only abandoned when the competition of ammonia ash had at length rendered it impossible to continue to sell soda products made from salts fished from highly cyaniferous liquors.

Cyanogen compounds *are* formed, then, in the black-ash furnace from the nitrogen of the mixing coal; but it does not follow that they are formed therein from the nitrogen of the mixing coal only. But, if the cyanogen compounds in black-ash are in part formed from other nitrogen than that of the mixing coal, neither does it follow that such other nitrogen is the nitrogen of the air May it not be the nitrogen of the firing coal, existing in the furnace gases as ammonia? I shall shortly publish some facts which I think will prove that this is so, and that to the formation of cyanogen compounds in black-ash by the reaction thereupon of ammoniacal compounds in the furnace gases, moderate temperatures are more favourable than higher ones. I believe this is the true explanation of the facts given in my former letter, and that the reason why my German friend failed to increase his cyanides by treatment of his finished black-ash with furnace gases was that he performed that treatment at too high a temperature.

Mr. Mactear's statement, unsupported by evidence, that the cyanogen compounds in black-ash are *not* formed from the nitrogen of the mixing coal I have disproved, then, by a fact. To the other statement, unsupported by evidence, that they *are* formed from the nitrogen of the air I have opposed only a suggestion. But I will supplement that suggestion by facts hereafter, and I feel sure I shall be able to prove that with the formation of cyanogen compounds in the black-ash furnace the nitrogen of the air has nothing whatever to do.

In the meantime, there is a fact well known to the whole English alkali trade, from which practical men will draw their own conclusion as to the soundness or otherwise of Mr. Mactear's doctrine, that "reducing the melting-point of the mass" reduces the proportion of cyanides formed in the black-ash furnace. Mr. Mactear's licensees,

before they adopted his mixing, used a larger proportion of limestone than they use now. Consequently the melting-point of their charges is now lower than it used to be. *Do they make whiter ash now than they used to make?* And who are the English manufacturers who make the *whitest* ash: those who use Mr. Mactear's low melting-point mixing, or those who use mixings having higher melting-points? Everyone in the trade knows the answers to these questions.

Mr. Mactear "protests" against my statement that, since the introduction of the Pechiney process, "more attention has been given by English alkali makers to the question of the cyanogen compounds in black-ash than they had previously given to it since the commencement of their industry." But that statement is true. During the last ten years I have spent a very large part of my time in going to and fro among alkali makers. Having an interest in nearly every work in the world in which chlorine is manufactured, and it being my duty to visit such works as often as I can, except my assistant, Mr. Cockburn, no one living is so familiar with so many alkali works as I am. Scarcely a day passes but he or I visit one or more alkali works. For the last ten years, then, I can speak from my own knowledge; for the longer period I appeal to the patent list. I have not time now to refer, but I believe I am right in saying that Mr. Williamson's patent of 1866 is the only patent for destroying the cyanogen compounds formed in black-ash making ever taken out by any English manufacturer before the introduction of the Pechiney process; whereas, within three weeks of my making that process known to any other manufacturers than the two who have been working it since the beginning of the year, three English manufacturers, Mr. Mactear being one of them, had applied for patents relating to that object.

Take Mr. Mactear's own case. I introduced the Pechiney process to him on the 23rd July. He had not then patented anything on the subject. On the 3rd of August he filed an application for a patent.

But Mr. Mactear says that the statement against which he "protests" is "unjust" to him. How so? Because his "experiments on the destruction of cyanides have been carried on since early in 1874?" The statement in question neither asserts nor implies anything to the contrary of that. And as to his having told me, "many months ago," of his destruction of cyanides in black-ash by caustic soda, his memory certainly deceives him.

And is it not a misuse of language to say, either of caustic soda put into the black-ash furnace, or of Mr. Williamson's heating the vat liquors to 310° F. under pressure, that they have been "perfectly successful?" I have not the smallest doubt that the cyanides can be destroyed completely by either method; but can a process of industrial chemistry be said to be "perfectly successful" when it has never been brought into regular industrial operation? As regards Mr. Williamson's process, I can speak from personal experience as to its perfect success in the laboratory; and though I do not think it could now compete with Pechiney's process, seeing that it requires a special operation, which Pechiney's process does not, I feel sure that, at the time it was proposed, it might have been industrially realised. But, as a matter of fact, it never was applied industrially. During the first experiment on the large scale something happened to the boiler, and Mr. Williamson did not pursue the matter further.

While admitting that "to M. Pechiney clearly belongs the honour of applying these known reactions to alkali making," Mr. Mactear says that it "is not a new fact in chemistry" that "sulphates of the alkalies added to cyanogen compounds destroy the cyanides," and that "the reactions involved" in Pechiney's process were described in "Watts's Dictionary" in 1864. It is very rarely that an improvement in alkali making is based on "a new fact." For example, the fact that for black-ash to dissolve readily it must contain free lime was not only known but acted upon long before Mactear's process, only people got their free lime into their black-ash, as most manufacturers do still, by other means than Mr. Mactear's method of adding it thereto just before the charge leaves the furnace. But is it quite certain that "the reactions involved" in Pechiney's process *are* the "known reactions" to which Mr. Mactear refers? What "Watts's Dictionary" says on the subject is simply that, according to Liebig, "Cyanide of potassium fused with sulphate of potassium yields cyanate and sulphide of potassium." But when Pechiney's process is properly performed, there are no cyanogen compounds at all in the resulting black-ash, and cyanate of sodium would still be a cyanogen compound. It is true that it would be sufficient for all practical purposes to convert the cyanide in black-ash into cyanate, seeing that by solution and evaporation cyanate of sodium is converted into carbonate of soda and carbonate of ammonia; and at one time I thought that that was how Pechiney's additional sulphate really acted. But well-made Pechiney black-ash does not contain any cyanate, nor any cyanogen compound whatever. Therefore "the reactions involved" in Pechiney's process must be other than the "known reactions."

Mr. Mactear declines to accept my "dictum" respecting the reason why cyanogen compounds are not found in the black-ash furnace till near the end of the operation. But I indulged in no mere assertion on that point. I simply drew what seemed to me the only reasonable conclusion from two established facts. That Pechiney's additional sulphate, intimately mixed with a charge of otherwise finished black-ash containing cyanide of sodium destroys that body, practically completely, is placed beyond dispute by the continuous results of several works in which the process has now been employed for considerable periods—in two cases for periods of nearly nine months. That is fact the first. Fact the second is that cyanide of sodium is not found in a charge of black-ash so long as any large proportion of sulphate remains therein undecomposed. Is it a mere "dictum" to suggest that the two facts are correlated? Admitting, as Mr. Mactear does, "that sulphates of the alkalies added to cyanogen compounds destroy the cyanide," how can he reject the obvious inference that either cyanide of sodium cannot form in a black-ash furnace while there is yet much undecomposed sulphate present, or that if it does form, the undecomposed sulphate instantly destroys it?

But Mr. Mactear says that he has "been able to obtain black-ash with considerably under 1 per cent of undecomposed sulphate, which was free from cyanogen compounds," by simply modifying his ordinary process by the reduction of his mixing-coal to under 29 per cent, and so enabling himself to effect the decomposition of his sulphate "at a temperature much lower than is usually employed." I can only congratulate Mr. Mactear upon having obtained such a result.

No one, however, knows better than Mr. Mactear how extremely difficult it is to get a fair sample of black-ash, and how great a difference there consequently nearly always is between the results of laboratory analysis of a black-ash and the tests of the vat liquors made from the same ash in the works. Will Mr. Mactear publish a week's tests of St. Rollox and Hebburn *vat liquors*, the details given to include Na_2S, Na_2SO_4 before oxidation, total Na_2SO_4 after oxidation, and Na_4FeCy_6—if any? If he will do that, I will gladly publish corresponding figures of Pechiney vat liquors.

Mr. Mactear throws doubt on my statement that Pechiney makes regularly by his process, and without separating any red liquors, soda-ash as free from iron and as good in colour as ammonia ash. I deliberately repeat the statement, and stake on it my credit for veracity. But it is *not* done by the means he suggests, and M. Pechiney's vat-liquors do *not* contain, as a rule, "a very large amount of NaCl." Mr. Mactear's statement that they do is based on a solitary analysis of a Salindres ash made at a time when an excep-

tionally hard kind of salt, corresponding to what I believe is called in England "pan-scale," and extremely difficult to decompose completely, was being used in his works. His ordinary sulphate is exceptionally rich, and his ordinary vat-liquors are correspondingly low in NaCl.

This is the analysis in question:—

Na_2CO_3	85·4
NaHO	8·0
Na_2SO_4	3·2
NaCl	4·0

Mr. Mactear throws doubt on my statement that Pechiney's additional sulphate "is decomposed into carbonate," as he puts it. To my distinct affirmation, based on figures supplied by all the works in which the process is being carried on, he opposes his—"I cannot see how it can be so." From "Watts's Dictionary," cyanide of potassium reduces sulphate of potassium to sulphide. Cyanide of sodium similarly reduces sodic sulphate, and sulphide of sodium and carbonate of lime, under the conditions which obtain in a black-ash furnace, decompose each other. The sulphate added at the end in Pechiney's process is reduced to sulphide, partly by the cyanide of sodium, partly by the free carbon, which are both usually present when it is added; and the sulphide so produced is converted into carbonate; when Pechiney's own mixing is used, by carbonate of lime still remaining in the charge at the moment of adding the final sulphate, and when the Pechiney-Weldon mixing is used by carbonate of lime added, usually in the state of "dust," at the same time as the final sulphate itself.

Mr. Mactear denies, "most emphatically," that it is to M. Pechiney that English manufacturers will be indebted—if ever they come to it, as I think they will—for the advantages resulting from the diminution of their mixing-coal to a minimum. To whom, then, is Mr. Mactear himself indebted for the recent diminution of his mixing-coal to "under 29 per cent?" He finds that he was "down to 28 per cent so far back as September, 1874." The way in which, in the last paragraph but one of his letter in your to-day's issue, Mr. Mactear speaks of his "ordinary process," distinguishing it from his 29 per cent process, is an admission that of his hitherto "ordinary process" the use of a minimum of mixing-coal was not a part. Mr. Mactear has therefore changed his process since the 23rd July.

A few English manufacturers, and notably the Messrs. Muspratt, have long used very small proportions of mixing coal, if not regularly, at least from time to time, for the production of special qualities of ash; but, to the mass of English alkali makers, that such decomposition of his sulphate as M. Pechiney gets can be got with the proportion of mixing coal he uses, has been quite a new revelation, and it is one which has reached them only in connection with my exploitation of his process for destroying cyanides.

Much of the French practice with very small proportions of mixing coal has been due to the fact, which till recently was unexplained, but of which I think we see the explanation now, that black-ash containing a large proportion of undecomposed sulphate contains no cyanides. To get black-ash free from cyanides, and therefore capable of yielding a perfectly white finished product, French manufacturers have been accustomed to deliberately use less mixing coal than would completely decompose their sulphate, and have been content in many instances, for the sake of getting perfectly white ash, to leave as much as 20 per cent, or even more than 20 per cent, of their sulphate undecomposed. M. Pechiney set himself to work out the problem of how, while decomposing his sulphate practically completely, to get a black-ash at once free from cyanide and containing so little sulphide that he should be able to make from it, without separation of any red liquors, as white an ash as had previously been got only when decomposing the sulphate very imperfectly. The means at which he ultimately arrived of dealing with the cyanide part of the question your readers already know; but he wanted also a means of obtaining, while decomposing his sulphate practically completely, a black-ash containing far less sulphide than is always contained in black-ash made with the proportion of mixing coal necessary to completely decompose the sulphate under the ordinary conditions of working. He found that means in the *combination* of a diminution of the mixing coal with a higher than the ordinary temperature at the finish, and a longer exposure thereto: "*Une cuisson un peu prolongée et à plus haute temperature à la fin.*" The advantage of this combination is what I claim for M. Pechiney the credit of having discovered, and for myself "of introducing a knowledge of;" and I challenge Mr. Mactear to find in the published researches of either Unger, Scheurer-Kestner, or my friend M. Kolb, anything which can render that claim invalid.

Great, however, as are the advantages of Pechiney's method of decomposing his sulphate, that method cannot always be adopted in England; nor, to the production of black-ash free from cyanides, is it essential that it should be. Whiter 58 per cent ash than had ever been made before without refining is now being got regularly in this country from black-ash made with over 60 per cent of mixing-coal, but freed from cyanides by Pechiney's final sulphate, and to a certain extent from sulphide by my final limestone dust.

In his final reference to the question of destroying the cyanides in black-ash, Mr. Mactear expresses the conviction that "something may be gained" by destroying those compounds instead of by sulphate of soda, by sodic hydrate, by the earthy sulphates, or by oxide of iron. When the cyanide of sodium in black-ash is destroyed by sulphate of soda, both the cyanide destroyed and the sulphate which destroys it are converted into carbonate, so that the destruction of the cyanide is not the only advantage obtained. The earthy sulphates, by reason of their infusibility, act so much more slowly than sulphate of soda that they are out of the question on that ground alone; moreover, they cost something, if not much, and whereas sulphate of soda employed for the purpose in question is converted into a product more valuable than itself, earthy sulphates so employed would simply be converted into more "waste." As regards oxide of iron and caustic soda, most people try to keep iron out of their black-ash instead of putting it in; while to convert sulphate of soda into sodic hydrate, and then employ that sodic hydrate to do what the original sulphate could have done just as well, is a proposal which no one would assent to.

I come now to what will be the last paragraph of what I intend shall be my last letter in reply to Mr. Mactear. He has fallen into error in reporting a part of what took place at our last interview. Although we did discuss the Pechiney process on that occasion, I had not gone to Glasgow to discuss that, but had made the journey thither from Liverpool, ill as I was, for the friendly purpose of communicating to Mr. Mactear some information affecting his interests, which had reached me by chance, which I thought might not have reached him from any one else (I found I was mistaken on that point), and which I believed (though I was mistaken on that point too) that it was important he should have without an hour's avoidable delay. It was he, and not I, who then proposed that we should work together; and he is mistaken with respect to the opinion as to "the process of the future," which a few courteous expressions of mine, imperfectly recorded, as was but natural, in a memory crowded with things of more moment, have misled him into attributing to me.—I am, &c.,

WALTER WELDON.

Rede Hall, Burstow, Surrey,
September 28, 1878.

[We can print no more letters on this subject.—*Ed.* C.N.]

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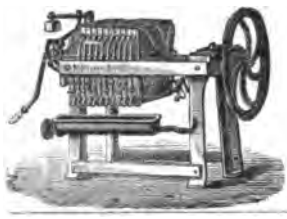

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 985.

THE NOXIOUS VAPOURS COMMISSION.

In a recent number of the Chemical News we gave a short account of the working of the Alkali Works Acts of 1863 and 1874, which will serve as an introduction to the present article, in which we intend to describe the causes which led to the appointment of the Commission on Noxious Vapours in 1876, and give a sketch of the evidence laid before them. The witnesses examined belonged to almost every class of the community, and the information given by them is extremely detailed and voluminous, plainly showing that the Commission have spared no pains to complete their task in the most thorough manner possible. Numberless witnesses repeated the oft-told tale of acres of fertile land laid waste by the action of alkali and copper fumes. Mr. Stow, a landscape gardener, describes the effects of these vapours on Halsnead Park, an estate about 5 or 6 miles from Widnes. The older trees were becoming stag-headed, and were no longer ornamental, while the oak, ash, beech, birch, and pine plantations were seriously damaged. Of the fir trees, for whose beauty the estate had at one time been famous, there is not a vestige now remaining. Bold Park, a couple of miles nearer to Widnes, presents a still sadder spectacle. Sir Richard Brooke, whose woods and park are within 8 miles from Widnes and 2½ miles from Runcorn, tells a similar pitiful story. The trees are nearly all destroyed, and up to the time he spoke more than three thousand had been cut down. The bark from the destroyed oak trees was also rendered completely valueless by the action of the vapours. There was hardly a healthy shrub on the entire property, and the hedges had been all destroyed and were replaced by fences at great cost. In the neighbourhood of the Tyne the damage done seems to have been just as great, a once-famous wood growing at Hepburn having been completely annihilated by the alkali and copper works.

The farmers are just as loud in their complaints as the owners of landed property. The growth of grass seems to be suddenly arrested by the passage of these vapours over it, and even hay, after it has been cut, was rendered unfit for food. Owing to the deleterious matter deposited on the grass, it acted injuriously on the cattle and sheep fed upon it, the former becoming hide-bound in a couple of years if not moved to a distant pasture. In some cases there was actual loss of life. The consequence of all this was the frequent surrender of farms by good tenants, which were re-let with difficulty to inferior tenants, the rents being either reduced or maintained only on condition that the landlord took the risk of damage caused by the works.

The effects on milch cows seem to be even more serious still. A farmer, whose farm was about three-quarters of a mile from Widnes and other works, kept fifty milch cows. Of these he had sometimes to kill ten or twelve in the year, owing to their livers and lungs becoming affected, at a loss of £5 or £6 per head. Five of his horses had also been killed from the effects of eating the poisoned fodder.

Sir R. Brooke had recovered £130 of an alkali manufacturer for damage done to corn valued at £240. Another farmer valued his annual loss in wheat at 12 bushels per statute acre. A nurseryman in the same neighbourhood described the gradual destruction of his fruit trees. He had not gathered a gooseberry for eight or ten years. He had claimed £250 damages, but only recovered a fifth of that sum. The damage done to similar crops in Tyneside is of the same character. Fruit trees, hedges, gorse, bramble, and thorn have all disappeared, the only plants which maintain the struggle for existence being the common elder and the deadly nightshade, which seem to be vapour-proof. Horses fed on hay and straw grown in this part of the country go wrong in their wind, while those fed on fodder brought from a distance are sound and healthy.

The evidence of the effects of the vapours on the human subject does not seem so conclusive, much of it being of an exaggerated character. The depressing influence of the vapours is borne witness to by several clergymen and medical men, but the manufacturers speak uniformly of the good health of their workmen, and Dr. B. W. Richardson—an exceptionally high authority on this subject—declares himself entirely unable to discover any evidence affording proper proof of any special deterioration of health in the neighbourhood of Widnes and St. Helens. On the other hand, Dr. Richardson says that the view so often advanced, that epidemics are prevented by the presence of the vapours, must be given up as untenable.

Thus much the evidence, so to speak, for the prosecution. The counter evidence is, however, particularly strong in some respects. One point is that the damage done is not due to the vapours from the alkali and copper works themselves, but to the acids contained in the ordinary coal-smoke of the district, and to the sulphuretted hydrogen produced by the contact of acids with the drainage of the alkali waste heaps. Another is, that the damage caused by alkali works was chiefly due to preventible accidental escape of gas, which could generally be traced to their authors and compensation made by pecuniary payments. The witnesses for the defence also declared that great improvements in vegetation had taken place since the 1863 Act had been in force, and in a still greater degree during the two years following the Act of 1874, due regard being had to the short time it had been in operation. Statements were also made to the effect that the value of the land in the neighbourhood of works had been largely increasing instead of diminishing, and that this increase fully compensated for such damage as was inevitable. A large amount of the mischief done was also stated to be due to the imperfect enforcement of of the Act of 1863 and to the stringency of that of 1874, and the impossibility of complying with its provisions on such short notice. Some valuable evidence was given on this side by Major Cross, who is an alkali manufacturer and chairman of the Widnes Local Board. While admitting that a large amount of damage has been done, even so late as 1872-74, he ascribes it mainly, if not entirely, to one or two works constructed hastily to meet a large rise in the market, and carried on in a most reckless manner. There were some manufacturers, too, upon whom no reliance could be placed, and large amounts of gas were allowed to escape at night, one field of wheat on his own farm having been destroyed by such an escape of chlorine. While, however, making these important admissions, he maintained that the selling and letting value of the land about Widnes had positively increased, and that great good had already been done by the Act of 1874. In 1854 the selling value of the land on which the present town of Widnes is built was worth £60 per acre; at present no land within half a mile of Widnes post-office is worth less than £1200 per acre, and some choice plots are worth four times that sum, land at 2½ miles from Widnes even fetching as much as £600 per acre. The letting value has also increased. Some agricultural land in possession of Sir Richard Brooke, at Cuerdley, which fetched £1 12s. 7d. per acre, now fetches £2 3s. With regard to the working of the Act of 1874, he stated that previous to 1872 he grew peaches in his garden a mile and a half from Widnes, but that in 1872, '73, and '74 the gases from his own and other works killed all the fruit and forest trees round his house, but that since the passing of the Act of 1874 he had fair crops of fruit and roses, and

that flowers grew luxuriantly. Major Cross's evidence, it must be remembered, referred entirely to the Lancashire side of the Mersey, the strongest cases of damage being on the Cheshire side. Other witnesses asserted, still more strongly, that the great amount of damage done was effected before 1863, and that both the value and rental of land had largely increased through the extension of alkali and other works.

In Tyneside, although it is asserted that a great improvement has taken place since the Acts of 1863 and 1874 have been in operation, the same increase in the value of land does not seem to have taken place.

The evidence of Dr. Angus Smith with reference to the destructive properties of ordinary coal-smoke is most instructive. According to him it is impossible to distinguish between the damage done by true smoke from that done by sulphurous acid proper. The soot carries away this acid, retains it, and, being deposited bodily on the trees and other vegetation, the destructive effects of the acid are localised and intensified.

When we estimate the good effects wrought by the Alkali Acts we must make allowance for the mischief effected by all works consuming large quantities of coal, which have hitherto been neglected by our legislators, except in certain districts. As to the amount of sulphurous acid produced by the combustion of coal, Mr. Eustace Carey adduced calculations which proved that the amount of sulphurous acid which escapes from his vitriol works is only one-sixth of that emitted by the combustion of coal used in his factory. Other witnesses produced similar figures, while others again—Dr. Richardson amongst the number—asserted that the acids produced by coal-smoke were comparatively harmless, instancing the more flourishing condition of vegetation in the neighbourhood of iron works as compared with alkali or copper works,

With regard to the mischief done by the sulphuretted hydrogen escaping from alkali heaps, Dr. Angus Smith is of opinion that it does but little harm to vegetation, except the drainage of the waste heaps overflows on grass. In the Tyneside district, where the working of the Acts seems to be regarded with greater favour than in Lancashire, the manufacturers have been in the habit of disposing of their alkali waste by throwing it into the sea—a process which one witness believes to be the only practical solution of the difficulty. We must leave it, however, to Mr. Frank Buckland to tell us what the crabs, lobsters, oysters, and other inshore Testaceæ and Crustaceæ, say to this invasion of their unmanorial rights.

Mr. Brook, an alkali manufacturer, who naturally pleads *pro domâ suâ* with much eloquence, persists that insufficient time has been allowed for compliance with the Act of 1874. The Act, he very justly observes, has forced on manufacturers a large expenditure of capital, and has required what is far more difficult to accomplish, namely, the education of all engaged in the manufacture to a pitch of refinement hitherto undreamt of. This refinement in working necessitates increased supervision; the more frequent repairs, and consequent stoppage of the plant, already entail a heavy extra charge. In spite of all this care it is still found impossible to carry out the provisions of the Act to the letter.

The evidence *pro* and *con* with respect to the Welch copper works is of a similar nature, the manufacturers fighting bravely for their cause, while candidly admitting the mischief done on the one side, and the good effected by the Acts on the other.

Mr. Hussey Vivian paints a sad picture of the decline of the copper smelting trade in North Wales, and begs hard that he and his brethren may not be interfered with. In twenty years the number of furnaces in work have dropped from 324 to 262, the value of the ore sold in Swansea from £698,000 to £393,000, and the quantity from 46,981 tons to 25,000 tons. On the other hand, the annual imported copper has risen from 5478 tons to 41,335 tons, the price of manufactured copper having fallen from £120 to £70 per ton. The Commission, however, decided against conceding to the Swansea copper works the exemption so eloquently pressed by Mr. Hussey Vivian, on account of their being situated in a deep valley, and their having been established so long that "the population which has planted itself around the works has accommodated itself to their condition." The latter plea reminds one of that of the vivisecting eel-seller of ancient days.

Coke-ovens were the next nuisances that claimed the attention of the Commission. Mr. Isaac Lowthian Bell gave valuable evidence on the mischief effected in this direction, and made a number of practical suggestions which were in part adopted by the Commission, as we shall see hereafter.

Salt works visited by Dr. Richardson seem to be, *per se*, comparatively harmless, the great damage being done by the smoke escaping from the boiler-flues. They are, however, to be inspected.

The Commission lastly transferred their labours to the London District, and visited Lambeth Potteries, Greenwich, Northfleet, and Battersea. The evidence given in these localities was sensational and conflicting, the medical men of these places generally telling pitiful stories of the sad effects of bad smells on themselves and their patients. Gold-refiners and glass-works were let off with a caution, and the Commission separated in August, 1878, after having done two years' heavy and valuable work.

NOTES FROM THE PARIS EXHIBITION.

On some of the Chemical Products.

Messrs. Griffiths, Fletcher, and Berdoe show, amongst other things, their new zinc-white, for which they have received the award of a silver medal. This zinc-white, the base of which is sulphide of zinc, is at present manufactured on a large scale by the Silicate Paint Company, of London and Liverpool. At the latter place, where the industry in question was originated, the factory produces 25 tons of Griffith's zinc-white per week, and a new factory, opened on the banks of the Thames, gives an output of 50 more tons for each seven days' work. Land has been secured for a still further increase in the output, and the manufacture will shortly reach 200 tons of paint per week. It has been subjected to a number of experiments, comparing its properties with those of white-lead and zinc oxide, and judgment has been given in favour of the zinc-white in all respects. One of the principal advantages in the employment of this paint instead of white-lead is that it is not injurious to the health of people who use it. It is also said that this zinc-white has a whiter tint than white-lead, and the colour is not affected by sulphuretted hydrogen. Another advantage is that the zinc-white covers better than either white-lead or zinc oxide; that is to say, that the same quantity of colour will cover a space 25 per cent larger than the former, and about 100 per cent larger than the latter, and it will not either blister or crack even if exposed to the most violent heat.

The Silicate Paint Company exhibit what they call a "Petrifying Solution," to be used as a wall distemper, to keep the damp out; it is a solution of silica, which has the property of closing up the pores in bricks, stone, cement, &c., and thus rendering the surface impervious to the rain. Plaster coated with the solution becomes hard, like cement; and stone or brick floors which have had a coating of the liquid prevent the damp rising.

Young's Mineral Oil and Paraffin Company has a very good exhibition of paraffin and the different oils and essences which they make. There are two very large blocks of paraffin, and samples of all the oils (of which the quantities made are given below). The manufacture of paraffin was first commenced in 1850 as a private undertaking, and it went on increasing in importance till, in

1866, the works were transferred to the above mentioned company, who have, since then, successfully carried them on. The raw material used was first taken from the Bog Head coal mines, but as that source became exhausted, the company began using bituminous schist, for the supply of which they have now twelve pits. They employ about 2100 men, and their annual production is very great. Below are given some of the quantities of oil, &c., which are made in a year.

Shale distilled	233,000 tons
Crude oil made	8,040,000 gallons
„ purified	9,680,000 „
Naphtha made	500,000 „
Burning oil made	4,000,000 „
Heavy mineral oil made	1,055,000 „
Crude paraffin made	6,190,000 lbs.
Refined paraffin made	3,940,000 „
Candles made	3,000,000 „

The total annual value of what the company produces is £500,000.

Messrs. James Chambers and Co. exhibit a quantity of colours, varnishes, and chemical products of their manufacture, also various chemical manures.

George Atkinson shows a quantity of colours which are specially prepared for printers' use; they are principally vermillion in different shades.

Messrs. Burgoyne, Burbidges, Cyriax, and Farries, who are wholesale manufacturing druggists, exhibit a quantity of chemicals and drugs which are used in pharmacy and medicine. They have been awarded a silver medal.

Messrs. Morson and Sons' case contains a very interesting collection of some of the finer chemical products; among them may be mentioned benzoate of ammonia, citrate of iron and quinine, pyrophosphate of iron, and a good quantity of salicine and pure iodine; they also show various salts of a number of poisons, as well as essences of different fruits, such as pine apples, and Jargonelle pears.

The Runcorn Soap and Alkali Works Company exhibit in their case some of the materials used in the manufacture of soap, they show some large crystals of soda and other products.

Messrs. Tennant and Sons have a large and interesting exhibition of the process for the refining of soda-ash by Mactear's method, they show bottles of soda, soda-ash, soda-ash refined, caustic soda, &c. They also exhibit the steps in the process of sulphur recovery by Mactear's method, and the manganese recovery by Dunlop's process. Messrs. Tennant and Sons have received the award of a gold medal.

Mr. James Readman exhibits several different compounds of phosphorus, and had in his case, at the commencement of the Exhibition, a large quantity of pure phosphorus, but it was removed on the 9th of May, at the request of the British Commissioners, owing to the danger incurred in exposing so great a quantity to the heat of summer; it was a wise precaution, as one of the bottles has had the top burst out, owing to the expansion of its contents. He also shows specimens of the different raw materials, and the stages in the manufacture of phosphate of soda.

The Washington Chemical Company exhibit a large block of magnesia, about 5ft. high, by 2½ft. wide, and 2½ft. thick. They have also several other specimens of magnesia in different states.

Messrs. Savory and Moore exhibit a number of medicinal compounds and chemical chests. One of their exhibits worthy of notice is a series of medicines, mixed with gelatine, to make them easier to apply; they are divided into four classes.

(1.) Ophthalmic, (2) hypodermic, (3) internal, and (4) external. The first, as may be seen by its name, is for affections of the eye; the gelatine mixture is applied so as to do away with irritation as much as possible. The second is for keeping, in a compact form, decomposable liquids. The third is for internal administration; it hides any unpleasant taste that the medicines might have. The fourth is for application on the skin to form blisters, &c.

The St. Bede Chemical Product Company (Limited), show in their case principally different samples of soda and its manufacture.

Britten's Patent Glass Company (Limited) exhibit specimens of what they call a new industry, viz., the utilisation of the slag from iron blast-furnaces. Many attempts have been made to utilise this product, which covers so many acres of once fertile ground in the iron districts, but it is generally considered as waste. It has been broken up for road paving, or made into blocks for building purposes; but as the product will not pay for its own transport, only a small quantity can be employed, and that only in the neighbourhood of the iron works. Several people have tried making glass of it, and have succeeded by adding the constituents which were wanting; but to get the slag to a condition in which the matter can combine, it has to be liquefied by heat, which involves very great expense. After many experiments, Mr. Britten has succeeded in utilising the material, and also the heat from the furnaces, and an English company has been formed to work his patent. The company has erected glass works in Northamptonshire, close to a set of blast-furnaces, and they are now in operation. The slag flows into a tank at one end, and is there mixed with the required ingredients for making the glass, fused and fined; the melted metal then flows through a bridge to the other end of the tank, where it is worked, and afterwards blown into bottles, &c. As the slag is already melted, it does not require so great a heat for the combination with the other substances, and also it furnishes more than half the material of the glass. Thus this glass costs less than glass made by the ordinary method. The natural tint of the glass is greenish, but it can be bleached or coloured at will. The furnace now at work produces 90 gross of bottles a day. It can be seen that it will be cheaper for iron-masters to have glass works attached to their own works, as the cost will not be so much as the always increasing cost of ground to dispose of their slag on. Below are one or two analyses of glass compared:—

	Britten's patent glass.	Sunderland glass bottles.
Silica..	64·4 per cent	53·25 per cent
Potash and soda	6·31 „	4·25 „
Lime..	16·37 „	25·5 „
Alumina and oxide of iron ..	11·87 „	15·0 „
Magnesia.. ..	0·64 „	2·0 „
Various	0·41 „	0·0 „
	100·00	100·00

Analysis of Different Specimens of Britten's Glass.

	Glass suitable for bottles.	Glass injurious.
Silica..	58·4 per cent	52·4 per cent
Potash and soda	11·7 „	4·4 „
Lime..	18·6 „	32·1 „
Alumina and oxide of iron ..	11·0 „	11·1 „
Various	0·3 „	0·0 „
	100·0	100·0

It is the excess of lime that is injurious; not more than 20 per cent should be present.

H. C.

Recovery of Gold from Old Cyanide Baths.—The liquid is super-saturated with hydrochloric acid, when a part of the gold is deposited. The rest is thrown down by means of zinc. Both precipitates are melted with 5 parts of ignited soda.—*Chemiker Zeitung.*

ON SCHUTZENBERGER'S PROCESS FOR THE VOLUMETRIC ESTIMATION OF OXYGEN IN WATER.*

By CHRISTOPHER CLARKE HUTCHINSON,
Royal Exhibitioner, Royal College of Science.

In judging of the character of a water for domestic uses, one of the most important points to be ascertained is the question of its pollution by sewage and other deleterious matters.

The determination of this pollution, its extent and nature, is at present rather unsettled. It is, however, believed by many chemists that a contamination, such as referred to, will exercise an effect upon the gaseous bodies held in solution in a water. It is the opinion of many that the relative quantity of oxygen present in a water affords the key to its deterioration by organic matter; because it is unlikely that a large quantity of oxygen can be held in solution by a water containing oxidisable matter. Waters which contain their normal proportion of oxygen, in relation to their other gaseous constituents, would be regarded as free from sewage and decaying matter; a diminution in the quantity of oxygen would indicate a corresponding increase in the amount of injurious matter present.

The late Dr. Miller's analyses of the gases present in the water of the Thames at various points clearly proved that as the amount of sewage *increased*, the amount of carbonic acid increased, and the amount of oxygen *decreased*.

The Rivers' Pollution Commissioners state in their Sixth Report that the proportion of oxygen in water is deprived of much importance, since it has been discovered that deep well-waters, which cannot contain putrescent organic matter, contain little or no dissolved oxygen. The absence of oxygen in deep well-waters, may, however, be owing to its having oxidised and destroyed the organic matter the water previously contained during its percolation through the strata.

In the presence of this conflicting testimony I was induced to undertake an investigation, in the hope of throwing some light upon this important question—whether or not the amount of oxygen present is, or is not, an indication of the freedom of a water from injurious organic bodies.

In commencing the inquiry I was desirous of employing some accurate and yet rapid method for the estimation of the oxygen present; for although the gasometric operations by Bunsen's method leave nothing to be desired in point of accuracy, yet on account of their somewhat tedious nature some other plan, if even slightly less accurate, but at the same time more rapid, would be desirable.

Such a method as this I thought might be afforded by the process devised by Schutzenberger for the volumetric estimation of oxygen in oxygenated liquids.† As the estimation is made without the removal of the oxygen by boiling, and in the condition in which it exists in the water, such a plan would seem to be more desirable than its expulsion from the liquid, together with the other gases held in solution, and their subsequent determination.

I now proceed to give the results I have obtained by means of this volumetric process.

Briefly described, the method consists in adding a known volume of the water under experiment to a solution which is capable of being oxidised (accompanied by a change of co our due to such oxidation) by the oxygen held in solution. The extent to which this has occurred is then determined, by the addition of a powerful reducing agent, which, acting upon the coloured compound so formed, reduces it to its former condition—the amount necessary being, of course, indicated by the reverse change of colour to that which occurred in the first instance. This last solution being standardised in terms of the oxygen it is capable of taking up, from the amount used in the experiment we arrive at the volume of oxygen contained in the volume of water taken.

The reagents used I will now describe with the method, and proportions for their preparation I found most advantageous.

The reducing agent used is sodium hyposulphite—not the commonly so-called "hyposulphite," but the sodium salt of the acid H_2SO_2; its formula as given by Schutzenberger is $NaHSO_2$. I prepared this as follows:—A concentrated solution of caustic soda (NaHO), sp. gr. 1·4, was taken; sulphurous anhydride (SO_2) was passed through it, until the liquid was thoroughly saturated, and smelt strongly of the gas. The yellow liquid (which was kept cool during the process of saturation by immersion in cold water) is sodium bisulphite ($NaHSO_3$); it increased slightly in bulk, and was reduced to the sp. gr. of about 1·34. 100 grms. (75 c.c.) of this solution was then briskly agitated in a flask with 6 grms. of powdered zinc, air being excluded; an elevation of temperature occurred, the bisulphite being converted partly into the hyposulphite, together with the formation of sodium sulphite and zincic sulphite, according to the following equation:

$$3NaHSO_3+Zn=NaHSO_2+Na_2SO_3+ZnSO_3+H_2O.$$

After agitation for about five minutes, the liquid was allowed to cool; 400 c.c. of water recently boiled were added; 35 c.c. of milk of lime, containing 200 grms. of CaO per litre, were also added, and the mixture allowed to stand until clear, when it was decanted off into well-stoppered bottles, and kept in the dark. The lime solution not only precipitates the zinc salt, but also renders the solution less absorbent of free oxygen, although it acts very rapidly upon dissolved oxygen. Before use this was further diluted with three times its bulk of distilled water, recently boiled.

The liquid recommended by which the change of colour detects the completion of the process is either carmine indigo (sulphindigotate of soda, $C_8H_4NaNOSO_3$), or Coupier's aniline blue. 10 grms. of the carmine indigo are recommended to be dissolved in one litre of water, the product being kept in well-stoppered bottles also in the dark.

An ammoniacal solution of pure copper sulphate is also recommended to be made, containing 4·46 grms. (or, more correctly, 4·471 grms.) of the crystallised salt per litre. This is to be used for the standardisation of the above two solutions.

Since the reducing agent is so sensitive to the presence of oxygen, it is necessary to make the estimations in an atmosphere of pure hydrogen. To ensure the purity of the hydrogen, I passed it through a solution of nitrate of silver, in addition to the sulphuric acid, and the tube containing pieces of caustic potash.

We begin by finding the volume relation between the indigo and hyposulphite. The burettes of the apparatus are filled, one with indigo carmine solution, the other with hyposulphite; a rapid current of hydrogen is passed through the apparatus, a small quantity of warm distilled water added, and this coloured by the addition of a small quantity of indigo. We now add cautiously the hyposulphite; the blue solution turns first green, and finally to a clear yellow tint. If the whole of the air has been expelled from the apparatus, the yellow tint will remain unchanged; the slightest trace of oxygen causes the surface of the liquid to become blue. A known volume of indigo (25 c.c.) is now added, and the hyposulphite solution again run in until the yellow tint appears, indicative of the reduction of the whole of the indigo. The colour change is exceedingly sharp, one drop being sufficient to change the colour from green to yellow. If the solution be acid, the blue colour changes first to red, and finally the yellow tint appears.

We next require to find the reducing power of the

* A paper read before the Royal Irish Academy, December 10, 1877.
† *Bulletin de Chemie et Physique*, vol. xx.

hyposulphite in terms of oxygen, finding from this the amount of oxygen any volume of the indigo will yield. This being a stable solution, the hyposulphite (being liable to change) can be readily standardised at any future time.

Two methods can be used, by which this reducing power can be found:

First. By finding the quantity necessary to reduce the ammonia copper solution, *i.e.*, the amount which brings the blue solution to a colourless state, by the reduction of the cupric to cuprous oxide; 10 c.c. of this solution yield 1 c.c. of oxygen (0° C. 760 m.m.s. pres.) to the reducer. 25 c.c. are operated on in a smaller apparatus, similar to the one used for the water estimations. I find, however, that the colour change in this plan is so indefinite and difficult, even to the practised eye, to detect that the exact point cannot be determined with any degree of certainty.

The second method consists in obtaining a pure water saturated with air, and then finding the quantity of hyposulphite capable of abstracting the whole of its oxygen.

This water is obtained by agitating in a large flask about one litre of distilled water with free access of air; the agitation is continued for about a quarter of an hour. To find the amount of oxygen in a given volume of the water, I made the following formula, from the consideration of the relative quantity of oxygen present in the air, and its coefficient of absorption in water:

$$v = 0{\cdot}0262 \times a_{t^\circ} \times V \times \frac{P}{95},$$

in which we have—

v = vol. of oxygen in c.c. at 0° C. and 760 m.m.s. pres.
a_{t° = coefficient of absorption of oxygen in water at temp. t° C., given by Bunsen's Tables.
V = volume of water employed, temp. t° C.
P = barometric pressure in m.m.s.

The relation between the saturated water and the hyposulphite is found in exactly the same way as the method, hereafter described, for the oxygen determination in waters. I found that, although the hyposulphite solution was about the strength recommended, the volume relation between it and the indigo, instead of being one to ten, was equal. As the indigo solution thus appeared ten times too concentrated I further diluted it for use.

The following is an example of standardisation by the above method. The apparatus was in every way regulated as described for water estimations:—

Comparison of Hyposulphite and Indigo.

Mean of five experiments gave—
25 c.c. indigo = 7 c.c. hyposulphite.

Comparison of Saturated Water and Hyposulphite.

Mean of five experiments gave—
75 c.c. of water = 2·4 c.c. hyposulphite,
from which is found—
25 c.c. indigo = 218·75 c.c. of water.
Temperature of water = 12·6° C.
Barometric pressure = 744 m.m.s.

We therefore have—

$$v = 0{\cdot}0262 \times 0{\cdot}031024 \times 218{\cdot}75 \times \frac{744}{95} = 1{\cdot}392;$$

therefore—
25 c.c. indigo = 1·392 c.c. oxygen.

I made determinations on different days at different conditions of temperature and pressure. The following shows the quantity of oxygen 25 c.c. of indigo was calculated to yield in each case:—

Temp., 12·6° C. Pressure, 744 m.m.s.	= 1·392 c.c.
Temp., 15·5° C. Pressure, 771 m.m.s.	= 1·448 ,,
Temp., 14·75° C. Pressure, 752 m.m.s.	= 1·354 ,,
Mean	= 1·398 ,,

The same amount of variation under widely different conditions shows this method of standardisation to be a reliable one.

I now proceed to give the method for the estimation of oxygen contained in a water. Owing to the change which the hyposulphite undergoes, it is necessary that a comparison between it and the indigo should be made each day. After this has been done and the apparatus freed from air by means of the hydrogen, 200 c.c. of warm water (temp. about 50° C.) are then added; 50 c.c. of indigo are now run in. This I usually effected in portions of about 15 c.c. at a time, decolourising each portion by means of the hyposulphite, thus utilising this step for the comparison of the two reagents; effecting thereby a saving of time and material. The liquid in the apparatus being now brought to the yellow neutral tint, a measured volume of the water under experiment is added—75 c.c. I found a convenient quantity—taking care that no air is admitted at the same time. The bleached indigo will now become re-oxidised, turning from yellow to blue, in proportion to the amount of oxygen present in the water. The hyposulphite is now cautiously added until we again arrive at the yellow tint, free from green; a single drop of the reagent is sufficient to effect the colour change at the proper point. From the quantity used we find the amount of oxygen present in this 75 c.c. of water. The operation can be repeated over again on another volume of the water until the apparatus becomes inconveniently full. I usually made from four to six such experiments in each case. The temperature of the apparatus must be kept at about 50° C. by the addition of warm water at intervals; the amount of hyposulphite required becomes gradually less as the apparatus cools, giving the results too low.

To test the accuracy of the method I took a measured volume of the same water at the time of the experiments, expelled the gases by boiling, collected this gaseous mixture, and determined its volume and composition by the usual methods of Bunsen's gasometric analysis.

The following examples are taken to illustrate the method of analysis.

Volumetric Method.

Mean of four determinations gave—
25 c.c. indigo = 8·21 c.c. hyposulphite.

This quantity of indigo we before found to yield 1·391 c.c. of oxygen. Therefore—
8·21 c.c. hyposulphite = 1·398 c.c. of oxygen.

Mean of five determinations gave—
3·55 c.c. hyposulphite = 75 c.c. of water.

From this we find the quantity of oxygen contained in 2·420 litres of water—the volume used in the gasometric method.

2·420 litres of water contain 19·505 c.c. of oxygen.

Gasometric Method.

Volume used .. .. 2·420 litres.
Temperature of water .. .. 13° C.

	Volume.	Temperature in °C.	Pressure in m.m.s.	Col. of Mercury above that in trough in m.m.s.	Corrected Vol. at 0° C. and 760 m.m.s. pres.
Total vol. of gas evolved	302·560	13·9	737	268·8	237·719
After absorp. of CO_2	316·149	14·9	745	229·2	193·959
After admission of H	503·600	14·4	765	55·2	439·066
After explosion ..	325·960	12·4	771	230·5	217·337

Percentage Volume Composition.

Carbonic acid	18·408
Oxygen	31·091
Nitrogen	50·500
Total	99·999

Absolute Volume Composition in c.c.

Carbonic acid	10·238
Oxygen	17·294
Nitrogen	28·087
Total	55·619

Volume of oxygen by volumetric method 19·505 c.c.
" " " gasometric " 17·294 "

Excess given by volumetric method .. 2·211 c.c.

Other samples from the same source were also experimented upon, the results being variable.

Water of a different character to this last was also experimented upon with the following result:—

Volumetric Method.

Mean of three determinations gave—
25 c.c. indigo = 7·25 c.c. hyposulphite;
therefore—
7·25 c.c. hyposulphite = 1·398 c.c. oxygen.

Mean of four determinations gave—
3·42 c.c. hyposulphite = 75 c.c. water.
From this we find—
2·420 litres of water contain 12·486 c.c. of oxygen.

Gasometric Method.

Volume used .. .. .. 2·420 litres.
Temperature of water .. 11° C.

	Volume.	Temperature in ° C.	Pressure in m.m.s.	Col. of Mercury above that in trough in m.m.s.	Corrected Vol. at 0° C. and 760 m.m.s. pres.
Total vol. of gas evolved	612·73	8·4	736·5	211·8	403·950
Gas used	369·04	8·4	736·5	211·8	243·294
After absorp. of CO_2	240·16	8·8	729·5	327·5	123·063
After admission of H	364·97	8·8	729·5	187·5	253·313
After explosion ..	261·20	8·7	729·5	296·0	141·584

Percentage Composition.

Carbonic acid	49·418
Oxygen	15·308
Nitrogen	35·274
Total	100·000

Absolute Volume Composition in c.c.

Carbonic acid	46·715
Oxygen	14·471
Nitrogen	33·343
Total	94·529

Volume of oxygen by volumetric method .. 12·486
" " " gasometric " .. 14·471

Difference .. .. 1·985

In this case the volumetric method shows a *less* volume of oxygen than the gasometric method. This, I think, is attributable to the large quantity of carbonic acid present; for, as Schutzenberger points out, when an acid is present in appreciable quantity, even such a weak acid as carbonic acid, the results given are invariably too low; hence this method would not be applicable, with any degree of accuracy, to waters in which a large quantity of carbonic acid is present.

I made numerous determinations, from which the two foregoing examples are selected; but none of them showed any trustworthy results; in some cases the volume of oxygen obtained being in excess, and in others less than that obtained by the gasometric method.

The variability of the results led me to inquire into the source of these discrepancies, and how they might be avoided.

Noticing that a change of colour in the yellow neutral tint seemed to occur to a greater extent than it should do on the addition of recently boiled distilled water, I made the following experiments:—

Distilled water was boiled in a flask fitted with a cork and exit valve so as to avoid contact with air, for over four hours. The apparatus was prepared as usual with indigo and hyposulphite, the temperature being kept at 50° C. The boiled water, which was kept in well-stoppered bottles, was then added in successive portions of 75 c.c. at a temperature of 55° C. On each addition a blue colouration was produced in the yellow neutral liquid, just as if oxygen had been absorbed by the reduced indigo. The amount of colour change was determined as usual by the addition of hyposulphite. The mean of five experiments showed that 2·9 c.c. were necessary to bring back the yellow tint. This quantity was found to be equivalent to 3·86 c.c. of indigo, or 0·201 c.c. of oxygen.

Unwilling to think that this was due to oxygen which had been left unexpelled by ebullition, I boiled recently-distilled water in long-necked flasks fitted with corks and exit valves for over five hours. The apparatus was prepared as usual, but in this case water at 100° C. was used, and the body of the apparatus immersed in water kept at 100° C. Portions of 75 c.c. of water were removed from the flasks whilst in a state of ebullition, and introduced into the apparatus; each addition caused a change of colour from yellow to blue. The mean of five experiments showed that 1·25 c.c. of hyposulphite was necessary to destroy the colour.

1·25 c.c. hyposulphite = 1·66 c.c. indigo = 0·08 c.c. of oxygen.

After boiling for over six hours the water was allowed to cool, out of contact with the air, and in withdrawing portions from it coal-gas was aspirated in instead of air, so as to avoid as far as possible contact with oxygen.

The same experiments were tried at the ordinary temperature (16·75° C.), and the same volume of water (75 c.c.) used. The mean of four experiments gave the colour change equivalent to 1·3 c.c. of hyposulphite = 1·56 c.c. of indigo, or 0·087 c.c. of oxygen.

The same experiments were now made at the temperature 0° C. by cooling the boiled water previous to its addition, and immersing the apparatus in a bath cooled by a mixture of ice and salt. The results in this case were variable, the introduction of 75 c.c. of water requiring from 0·9 to 2·4 of the hyposulphite. I found this to be due to the length of time the apparatus was allowed to stand in the bath after the introduction of the water. The longer the time the less the quantity of the reagent required to destroy the blue tint produced. To make certain that such a change did occur I brought the liquid to a yellow tint, and then added a few drops of indigo so as to produce a distinct green colour. On allowing the apparatus to stand in the bath this gradually disappeared. I tried this several times, adding variable quantities of indigo in excess; but in all cases (within certain limits) when allowed to stand in the cold water the green colour was gradually replaced by the yellow tint, just as if a quantity of hyposulphite had been added.

I attempted to remove these errors by a modification in the method of procedure.

The burette used for the indigo was replaced by a larger one (100 c.c. capacity). After placing in the apparatus a quantity of indigo solution, expelling the air and bringing to the neutral point as usual, a known excess of the hyposulphite was added. Saturated water, as before described, was then added from the large burette, so as to oxidise the excess of hyposulphite, and just tinge the liquid green. From the volume required, by using the formula before given, the volume of oxygen contained in this can be found; hence the equivalence of the excess of hyposulphite in terms of oxygen. The same operation is performed with the water under experiment acting

upon the same excess of hyposulphite. The relation between the volume used and that of the saturated water gives the amount of oxygen in the liquid. Any errors resulting from change in the solution would thus be eliminated, and the calculations simplified. On trying this method, I did not find the results any more satisfactory than the original method, although performed with the greatest care; they gave quantities in excess of that given by the gasometric method. Thus, in 2·420 litres of water,

Volumetric modification gave.. ..	15·133 c.c.
Gasometric method	12·650 ,,
Excess	2·483 ,,

Although this volumetric method possesses the great merit of exceeding rapidity, yet the many precautions necessary to be taken greatly detracts from the value and reliability of the results. It seems to be better suited for the determination of oxygen in small rather than in large quantities of a liquid, such as are desirable in water estimations. It is also valuable as a means of showing whether it would be desirable to estimate the amount of oxygen present in a water, by the more accurate methods. The process adopted by Schutzenberger for checking the results appears to have been submitting the liquid to the action of the mercury pump for fifteen or twenty minutes. I do not think this is sufficient, for, in expelling the mixed gases from a water by boiling, I have found that traces of gas are given off even after a considerable period.

The great drawback is the considerable amount of change the hyposulphite solution undergoes, even when excluded from the air and kept in the dark. The following give the volume ratios between it and the indigo, as taken on different days, showing the extent of this change:—

Oct. 23.—25	c.c. indigo	= 7	c.c. hyposulphite.		
,, 25.—25	,,	,,	= 7·84	,,	,,
,, 27.—25	,,	,,	= 9·8	,,	,,
Nov. 1.—25	,,	,,	=13	,,	,,
,, 6.—25	,,	,,	=20·75	,,	,,

These investigations were carried out in the Chemical Laboratories of the Royal College of Science, under the supervision of Professor Galloway.

NOTICES OF BOOKS.

Truths about Whisky. London: Sutton, Sharpe, and Co.

In one sense the little work before us must undoubtedly be regarded as a trade-publication, written to promote the business of the eminent firms under whose auspices it is issued. Were this its only object then, however truthful its statements, it would scarcely be entitled to notice in our pages. But as it is, at the same time, destined to expose an abuse in an important branch of chemical manufactures—an abuse injurious alike to the consumer and to the honourable producer—it comes legitimately within our cognisance. There is a popular notion that distilled spirits, and especially whisky, are merely dilute alcohol, and that the nearer they approach to this standard the better is their quality. Against this view the authors enter a decided protest. They define whisky as a spirit prepared from grain, whether malted or not, and distilled "in a so-called pot-still," which brings over, together with the spirit, a variety of flavouring and other ingredients from the grain. Such a spirit, if carefully made from good materials, undergoes important chemical changes on keeping, and whilst it loses strength, *i.e.*, falls in its percentage of alcohol, it gains flavour and aroma from the development of certain ethers.

On the other hand, the rival liquor which has gradually, by reason of its lower cost of production, been supplanting whisky in the market, and which is known in the trade as plain or silent spirit, is made from promiscuous vegetable products, by the aid of a "patent still," which, if properly managed, brings over merely alcohol and water, leaving behind the flavouring matters, or rather the bodies from which they might ultimately be developed. This silent spirit undergoes no change on keeping; it never requires any aroma, and though admirably suited for use in the arts, it never can become whisky, though it may be imposed upon the public as such, by dint of certain mysterious drugging operations.

Having drawn this perfectly legitimate distinction between whisky and silent spirit, the authors proceed to give a history of the fraud against which they are contending. The whisky of the best Dublin distillers was first mixed by dealers with whisky, genuine indeed, but of a cheaper and coarser character, or as we may explain it, made in a pot-still, but from inferior materials, and by less skilful hands. The whole mixture was then, of course, sold at the price of the more costly of its components, and the public were taught that, by dint of this "blending" process, an article was produced superior to any of the original materials. Silent spirit was next introduced, mixed with the coarsest provincial whisky, and then sold as the genuine Dublin product. This malpractice was found highly profitable, as silent spirit can be manufactured at a much lower cost than true whisky. Hence the honourable manufacturers of whisky had only two alternatives left; either to enter into the blending system themselves, or to "fight it out," by explaining to the public the frauds which were being practised, and especially by exposing the facilities for imposition afforded by the Customs Regulations.

In the most important points we are thoroughly at one with the authors of this pamphlet. We may, indeed, be scarcely able to repress a smile at the enthusiasm which appears in their description of genuine whisky, and we may be somewhat sceptical as to the position they assign to it in comparison with natural, *i.e.*, unbrandied and unplastered wines. But we agree with them entirely in their implied admission, that the dietetic value of a fermented or distilled liquor is to be estimated by its percentage of alcohol, the very reverse being often the case. We applaud their remarks on "blending"—an evil by no means, limited to the whisky trade, but carried on to an equal extent in wines. Time was when the growths of different vineyards, differing as they do in flavour, were carefully kept distinct. Now, forsooth, instead of being asked to buy Marcobrunner, or Niersteiner, or Liebfrauenmilch, &c., we are offered our choice between Rhenish *a*, Rhenish *b*, and the like. In Burgundies and clarets all trace of the distinctive origin of the sample is disappearing in the same manner. Closely connected with "blending" is another modern mischief complained of by our authors, that the importer or other large dealer is gradually usurping the place rightfully due to the producer.

Attention is drawn in this work to a point of great physiological and sanitary interest, which has been far too little regarded. Our authors consider it strange that the leaders of the extreme temperance party "should have so completely left out of account, in the various experiments which some of their body profess to have conducted, the way in which the action of alcohol may be modified, by the various substances with which it may be combined. We read, for example, of experiments made with 'brandy,' but what is brandy?" We should be very reluctant to argue from the observed effects of pure alcohol, diluted merely with water, to those of a similar quantity of alcohol present in wine, beer, or true whisky.

A few statements are made to which, from a chemical point of view, we must object. Thus, rectified spirit is described as being a "solvent for gums." True gums are insoluble in alcohol, though it readily dissolves the gum-resins—a distinct class of bodies. Again we read that the difficulties in the way of permitting the free use of alcohol in the arts have been overcome, "by the discovery

that spirit may be impregnated with an offensive substance, called 'methyl,' which cannot be removed by rectification, and which is no nauseous that it cannot be drunk. This methylated spirit is allowed to be sold duty free, being wholly unfit for human consumption; and it has rendered possible the unrestrained employment in the arts."

Here are several errors; the liquid added to spirit is not methyl, but methylic alcohol, which is further required to be itself in an impure condition, otherwise—though at what limit the Revenue authorities have refused to say—it also is liable to duty. The mixture of ordinary spirit and methylic alcohol,—known as methylated spirit, though admittedly nauseous, is greedily drunk by workmen in the establishments where it is used, and so far from its employment in the arts being "unrestrained," unless the consumer is prepared to give security for £1000, the revenue insists on the further addition of a quantity of shellac, than which it would be difficult to devise an admixture more fatal for all purposes, save those of the varnish maker.

We will conclude this notice of a timely and useful pamphlet with quoting some not unmerited strictures levelled at certain members of our own profession:—"The case is not one for genuine chemists, although it is well suited for puffs, written by analysts whose business it is to find nothing but all sorts of negative and positive excellences in the preparations made by their employers. It is a pity that the heads of the profession of chemistry, which is every day becoming of more importance in the arts, cannot stop a use of chemical certificates, which is degrading not only to those who issue them but also to the general body to which such persons belong. There are some well-known analysts whose names are never advertised as testifying to the purity of somebody's black lead or ginger beer; but even the public utterances of these men are held of less account than they should be, by reason of the facility with which chemical certificates about anything may be obtained from men whose names are followed by all the letters of the alphabet.

Preparation des Lins et Chauvres sans Rouissage Putride. (Preparation of Flax and Hemp without Rot-steeping.) Système J. T. Lefebure. Bruxelles: I. J. Baertsoen.

It is well-known that flax and hemp are ordinarily prepared for use by being laid to steep in water until the extractive and gummy matters are destroyed by putrefaction. The smell given off by the steeping pits is extremely offensive, and in flax-growing districts there are frequent complaints of rivers and wells being contaminated by the escaping waters. M. Lefébure first removes the so-called straw, the outer coating of the flax stem, by the aid of a machine, into which the flax enters in its green state, and comes out in a few seconds perfectly decorticated. It is then plunged in a solution of soda, which frees it entirely from gum without the least injury to the fibre. The duration of this second operation is from two to five hours, according to the more or less serious nature of the sample. In addition to the suppression of nuisance, the flax is obtained in a state of complete disaggregation, and without any injury to the fibre, and is necessarily finer, stronger, and more regular.

CORRESPONDENCE.

SUGAR TESTS.

To the Editor of the Chemical News.

Sir,—I observe that in the newest work on sugars I have consulted, viz., "De L'Analyse des Sucres," par M. Wousseu, Paris, 1878, under the rules for preparing sugar solutions for the saccharimeter, directions are given for rejecting an amount of sugar solution equal to three times the bulk of the bone-char employed.—I am, &c.,

J. M. Merrick.

Laboratory, 59, Broad Street, Boston, U.S.A., September 24th, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 13, September 23, 1878.

Dissociation of the Oxides of the Platinum Group.—H. Sainte-Claire Deville and H. Debray.—Platinum is distinguished from the other metals present in its ores by the fact that it does not combine directly with oxygen, in whatever condition the two bodies may be placed. With rhodium, palladium, and iridium the case is otherwise. If heated in a muffle, at a temperature not too elevated, these metals combine with oxygen, but their oxides are decomposed at a stronger heat. Osmium and ruthenium combine directly with oxygen. The product of this oxidation is volatile, and is formed at the highest temperatures. Osmium most strongly ignited, though less alterable than osmium obtained at a low temperature, is transformed into osmic acid, even at the common temperature. Ruthenium behaves exactly like osmium. The metal, after strong ignition, is oxidised in the muffle at a temperature scarcely above 400°, and is volatilised in abundance: it is difficult to say in what state, for the substance always gives off the odour of ozone, the formation of which always accompanies the decomposition of hyperruthenic acid. Possibly the product deposited in the muffle is the binoxide. This oxide is obtained in crystals, in a tube of porcelain traversed by a current of oxygen, in which matters containing ruthenium are heated. It is thus that M. Fremy has proved its volatility, and discovered the means of extracting it directly, and in the most beautiful forms, from amongst the products of the roasting of the osmide of iridium. Thus ruthenium, which in the metallic state is one of the most fixed matters known, evaporates rapidly in a muffle. These properties absolutely distinguish osmium and ruthenium from the other platinum metals. These two, by the manner of their behaviour in contact with oxygen, evidently approximate to arsenic and antimony, and, like these latter, might be placed amongst the non-metallic bodies. With rhodium, palladium, and iridium the case is different. Their oxides can be decomposed by heat, and thus the laws of their dissociation and the tension which it takes at different temperatures can be ascertained. For iridium the following numbers have been found:—

Temperatures.	Tension of Dissociation. m.m.
822·8	5·00
1003·3	203·27
1112·0	710·69
1139·0	745·00

Reply to the Observations of M. E. Marchand.—A. Adam.—The author defends the value of his process. He declares that—"The lacto-butyrometer estimates only the butter: I give the butter, the lactine (lactose), and the casein. M. Marchand does not determine the butter; he merely deduces it from an empirical formula based upon two hypotheses. In my process I isolate, collect, and weigh the three bodies. In the lacto-butyrometer everything takes place in the interior of a closed tube, and escapes control. In my process each is successively with-

drawn from the apparatus, collected without loss, and submitted to the balance."

La Correspondance Scientifique.
October 1, 1878.

This issue contains an elaborate notice of the recent work of M. Th. Du Moncel, on "The Telephone, the Microphone, and the Phonograph." The writer quotes with approval the dispassionate and authoritative decision of M. Du Moncel on the controversy recently waged concerning the invention of the microphone. He urges that if the physical principle of the microphone may seem to be identical with that of Mr. Edison's telephonic carbon transmitter, its arrangement is entirely different, the manner of acting upon it is not the same, and the effects ordinarily required of it are of a totally different nature. There is more than what is really needed to constitute a novel invention. Further, Mr. Edison cannot claim, as specially belonging to himself, the discovery that certain bodies moderately conductive can have their conductivity modified by pressure." After pointing out three capital distinctions between the microphone and the telephonic transmitter, M. Du Moncel asks—"Why, if Mr. Edison has invented the microphone, did he not make known its properties and its results?"

Civilisation among Ants.—From this paper we learn that M. Berthelot, the illustrious chemist, is also a zealous entomologist, and has for a quarter of a century been engaged in studying the manners of ants.

Chemiker Zeitung.
No. 39, September 26, 1878.

In France the number of workmen engaged in the manufacture of lamps is 4500, and the annual production is of the value of 35 million francs; 2000 workmen are concerned in the manufacture of gas-fittings, and their work represents a yearly value of 10 millions. About 400 dynamo-electric machines for the production of light are manufactured annually in Paris.

The Future of Chemists.—The writer gives his views as to the training of a "works' chemist." After his education at a "real" school—a kind of establisment which can scarcely be said to exist in England—he is to serve as a "volunteer" for some two or three years, according to the department of practical chemistry he intends to select, in brewery, tannery, alkali-works, print-works, &c. *After* this practical training he is to complete his studies at the University or the Polytechnicum, and in addition to theoretical and analytical chemistry, physics, and chemical technology, he is to make himself master of the differential and integral calculus, of descriptive geometry, mechanical technology, machine-making, architectural planning, and designing and land-surveying!

[Is not a knowledge of the patent laws of all civilised nations still more likely to be useful than many of these last-named studies? Does not this entire programme ignore the great principle of the division of labour which is continually becoming more important as each science and its application become more extensive and complicated?—*Ed.* C. N.]

The "International Association against the Pollution of the Rivers, the Soil, and the Air" held its Congress at Cassel, on the 9th and 10th of last month.

Borax-soap is recommended as the best agent for removing traces of grease from beakers, test-tubes, &c.

M. H. W. Langbeck proposes the following method for detecting the least traces of methyl in ether, chloroform, &c. He mixes 10 volumes of the suspected sample with 1 volume of a solution of silver nitrate, containing 1·7 per cent of the dry salt, and allows the mixture to stand for twenty-four hours. After the lapse of this time the line of contact of the two liquids has assumed a faintly reddish violet colour, and a reddish brown precipitate of silver oxide is found, more or less abundant according to the proportion of methyl present.

Dr. E. Büchner has devised an apparatus for measuring the current of air in flues, vitriol-chambers, &c. His invention consists, first, of a kind of anemometer; and secondly, of an electro-magnetic apparatus. The former apparatus is fixed in the place where the draught is to be measured, and is thrown into rotation, quicker or slower as the case may be, which is transferred to the electric apparatus. The measurement is performed by noting the number of revolutions in a given time.

J. Cabot, of Boston, patents a mordant for aniline colours which may also be used with iron for the production of light greys, slates, &c., on cottons and on mixed goods. It consists either of gallic acid and an alkaline hyposulphite, or of finely-ground galls and sulphate of potash.

Paupert and Arnoult propose to extract ammonia from liquids by distillation in a partial vacuum, lime being introduced into the stills, and the ammonia-vapours arrested by any known means.

Bulletin de la Societe Chimique de Paris,
Tome 30, Nos. 4 and 5, Sept. 5, 1878.

At the last meeting of the society, M. Ch. Girard gave an account of the researches undertaken by M. Caventon and himself, on the action of azoxy-benzide and azo-benzide upon the primary, secondary, and tertiary monamines. On the action of nitro-benzin upon hydrochlorate of aniline, in presence of iron, there are formed several colouring matters—a mixture of violanilin, $C_{18}H_{15}N_3$, and of triphenylen-diamin blue, $C_{18}H_{12}N_2$, &c. These bodies may be obtained by one of the following processes, action of arsenic acid upon aniline; action of amido-azo-benzol upon pure hydrochlorate aniline; action of azoxy-benzide upon pure hydrochlorate of aniline. The blue colouring matter obtained by MM. Dechend and Wichelhaus, by the action of nitro-benzin upon diphenylamin, is very easily prepared, by allowing azo-benzid to react upon the hydrochlorate of aniline. In this reaction there is formed a certain quantity of hydrazobenzide, which is decomposed by heat into azo-benzide and aniline. The author remarks that whilst by the action of azoxy-benzid upon the hydrochlorate of diphenylamin, or methyl-diphenylamin, there are obtained substitution colouring matters of the violanilin class, another series of colouring matters may be obtained by operating with azo-benzide upon the hydrochlorate of diphenylamin or of ethyl-diphenylamin. M. Nölting communicated to the Society certain experiments undertaken by M. Reverdin and himself, to ascertain the influence of the alkaloids, which, in small quantities, accompany dimethyl-anilin in commercial methyl-anilin, upon the production of violet. These are mono-methyl-anilin, the two mono-methyl-toluydins (ortho and para), and the two dimethyl-toluydins. The three secondary amines were prepared by the reduction of the corresponding nitrosamines; the two dimethyl-toluydins by the distillation of the chlorides of trimethyl-tolyl-ammonium. The mono-methyl-anilin boiled between 191 and 193°. The mono-methyl-ortho-toluydin, which has not yet been described, boils at 207—208°; its isomer of the para series at the same temperature, dimethyl-ortho-toluydin at 182—183°, and dimethyl-para-toluydin at 288°. These bases were submitted to oxidation by the chloride of copper, under the conditions used for dimethyl-anilin. Mono-methyl-anilin furnished a red violet, though less red than the mono-methyl-rosanilin obtained by the action of the chloride of methyl upon rosanilin; mono- and dimethyl-ortho-toluydin yield also a reddish violet—that of the tertiary base being more blue than that from the secondary; the two methylated derivatives of para-toluydin,

on the contrary, do not yield violet but yellow colours of little lustre, whose presence in a violet degrades the shade. It appears, therefore, that in the industrial preparation of the violet, it is important to employ pure dimethyl-anilin, and especially to avoid the derivatives of para-toluydin, which, as their high boiling-point indicates, are to be found in the tailings. The authors have made some experiments on the part of meta-toluydin in the production of aniline red. They have first observed that commercial toluydin contains traces of meta-toluydin, which they have not been able to isolate, but whose presence they have been able to ascertain with certainty by the examination of the nitro-toluol which had served for the preparation of this toluydin. In fact, by oxidation with permanganate, they have obtained, along with ortho- and para-nitro-benzoic acid, a small quantity of meta-nitro-benzoic acid, proving the presence of meta-nitro-toluol. To prepare meta-toluydin in a state of purity, they have followed the process of Beilstein and Kuhlberg. The meta-toluydin was then oxidised with arsenic acid, both alone and mixed with aniline, and the two other toluydins. The following are the results obtained: meta-toluydin alone, brown; meta-toluydin and aniline, violet; meta-toluydin and para-toluydin, brown; meta-toluydin and ortho-toluydin, a violet red and grey. Meta-toluydin is thus clearly distinguished in its colour-reactions from its two isomers; para-toluydin alone gives a yellow; chryso-toluydin, its mixture with aniline or ortho-toluydin, and the latter alone yielding a fine red.

Dissociation of Metallic Sulphides.—Ph. de Clermont and J. Frommel.—The authors establish that the hydrates of the sulphides are dissociated by heat, more or less rapidly, according to the tension of each of them. The sulphides of iron, nickel, cobalt, antimony, tin, arsenic, and silver are dissociated; whilst those of copper, zinc, mercury, cadmium, gold, platinum, and molybdenum resist.

Correction of a Note on Ethoxy-acetonitrile.—T. H. Norton and J. Tcherniak.—The authors recognise the priority of Prof. L. Henry, as regards the discovery of the substance in question.

Bichloro-propionate of Ethyl.—M. L. Henry.—The author points out an erratum in the published boiling-point of this liquid.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 3, Sept. 19, 1878.

Ammoniacal sulphate of copper has been found useful in the treatment of epileptical neuralgia of the face.

With reference to the explosion of objects of tempered glass, it is remarked that the future of this novel industry is fatally limited, and that the utility of articles so prepared is not greater than that of Prince Rupert's drops, from which they differ merely in form.

It has been proposed to illuminate harvest-fields, &c., by the electric light, so that agricultural operations can be carried on if necessary after sunset.

Reimann's Färber Zeitung,
Nos. 34, 35, and 36, 1878.

These issues contain nothing of general interest.

MISCELLANEOUS.

The Awards at the Paris Exhibition.—We have tried in vain to obtain an authentic list of the awards made to British exhibitors at the Paris Exhibition. The lists published by the daily press, which first appeared in the Paris papers, are incorrect and incomplete. Many exhibitors having received letters informing them that awards have been made for their exhibits we shall feel obliged those who have obtained prizes for chemical products and philosophical apparatus will kindly send us particulars.

NOTES AND QUERIES.

Test for Anthracen.—Will any chemist kindly give me th details of Fritsche's picric acid test for anthracen?—J. W. T.

Estimation of Phosphoric Acid.—Will any of your readers kindly give me working particulars of Sonnenschein's method of estimating phosphoric acid, through the medium of your valuable journal? By so doing I shall be greatly obliged.—Subscriber.

TO CORRESPONDENTS.

J. H.—We do not know a better book. See article on the subject in "Watts's Dictionary."

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 986.

ON SOME

PECULIARITIES OF THE VARTRY WATER, AND ON THE ACTION OF THAT WATER UPON BOILER-PLATES.*

By CHARLES R. C. TICHBORNE, LL.D., Ph.D., F.C.S., &c.

The water of the River Vartry, from which we get our supply in Dublin, has been repeatedly analysed, therefore I will not trouble the Section with a detail of its composition. It will be sufficient for my purpose to remind the Section of its general composition, which may be stated to consist of—

Organic matter of a peaty nature, 1·6 to 2 grains per gallon.
Mineral matter, 2½ grains.
Chiefly consisting of chlorides of the alkalies and the alkaline earths in equal proportions.

The hardness is nearly all permanent, as there is but a trace of carbonates present. The point I wish to draw attention to, however, is the presence of nitrates and nitrites. The first are always present, the latter occasionally in the summer and autumn months. They were present when last tried on the 3rd of August. I have never seen any published analysis which mentions the existence of these acidulous radicals. As my object is to determine the conditions of the nitrogen salts, and as heat seems to reduce nitrates when occurring in this water, I had recourse to evaporation by the aid of a vacuum and sulphuric acid, the test I used being the brucin test, an extremely delicate one if properly applied. For my nitrites I used a thin starch solution made with a little dilute glycerin to keep it, and a solution of tartaric acid preserved by a little salicylic acid, the iodide of potassium being carefully purified from iodate. The solutions keep very well, and are reliable. The iodide should be dissolved as required. The Vartry water does not give indications with the tests as a rule without concentrating it. I subjoin the results of my experiments on the 3rd of August:—

1. Water evaporated to one-third at 100° C. gave a very striking indication of nitrites besides nitrates.
2. Evaporated in a vacuum to one-third, it gave no indication.
3. Evaporated to a quarter it gave an indication of nitrites and nitrates.

In January, 1878, the Vartry gave no indication of nitrites, but contained as usual nitrates, and gave an indication on evaporating to one-half.

We see by these observations that evaporation tends to reduce the nitrates; also, that from fermentation action changes occur at certain periods of the year, which result in the reduction of nitrates to nitrites.

We see also that these nitrates and nitrites are present in very minute quantities. I have never found 0·1 of a grain per gallon said to be present in Loch Katrine water, the highest amount I have ever found being 0·06, determined by the aluminium process. But still when these salts are rapidly concentrated, as they are in the feeding of high pressure steam boilers, the nitrogen salts become very serious items of corrosion, owing to the ease with which the acidulous radicals are dissociated at high temperatures; *e.g.*:—

$$NaNO_3 = NaNO_2 + O.$$
$$2NaNO_2 + H_2O = 2(NaHO) + 2NO.$$
$$2NO + Fe = FeO + NO.$$

I exhibit a boiler plate, which is not only eaten away by the corrosive action of water, but the corrosion is determined by the steam of the Vartry water. I also exhibit glass corrosion produced by the same means. Some experiments were instituted in sealed tubes which bear strikingly upon this subject, and which I now beg to place before the section.

No. 1.—In this experiment distilled water was boiled down in a tube, and a piece of bright wire inserted. The tube was then sealed after the air had been exhausted. It is now some months old, and it will be observed that there is comparatively no action. We are to infer, therefore, from this experiment that at ordinary temperatures water is without the slightest action upon iron *in vacuo*. We all know how rapidly iron is oxidised in the presence of water containing air.

No. 2 is iron sealed up *in vacuo* with Bartry water, and submitted to high pressure steam at 30 lbs. to the square inch. The action is sharp and well marked, the results being the production of ferric oxide in considerable quantities and magnetic oxide. The latter can be recognised on applying a magnet outside the tube.

The third tube was a similar experiment with pure water, containing 0·1 grain per gallon of nitrate of potassium. This was also sealed *in vacuo*. The results are almost identical with the second experiment, only that more magnetic oxide seems to have been formed.

The fourth experiment was one in which a nitrite was substituted for the nitrate. Here nothing but ferric oxide was formed of a peculiar bright colour and in scales.

That the corrosion of the boiler plate mainly proceeds from the nitrogenous molecules, I think there can be little doubt. But the quantity of these acidulous radicals, being very small, any of the alkaline preservatives would remedy this corrosive action. If, however, neglected, these nitrogenous acidulous radicals would almost certainly lead to mischief, and, therefore, they are imminent sources of danger.

* A paper read before the Chemical Section of the British Association at Dublin.

ON SOME COLORIMETRICAL EXPERIMENTS.*

By JAMES BOTTOMLEY, B.A., D.Sc.

If a white disk be sunk in a coloured solution, the intensity of the colour perceived will be a function of the depth of the disk and the quantity of the colouring matter present. If, in any set of experiments, we make the intensity of colour constant, then the depth of the disk will be a function of the quantity of colouring matter only. Occasionally in chemistry we have to deal with quantities so minute that we can no longer use the balance for their determination, and yet those small quantities when they yield coloured solutions are evidently comparable among themselves. In a short communication which I made to this Society (vol. xv., 63), I suggested that such a process as above indicated might be applied for the measuring of such traces, assuming that the depth of the disk would be inversely as the quantity of colouring matter present. Some experiments were made on colouring matter in solution. Glass cylinders were used about 10 in. high and 2 in. diameter. To one side of each cylinder was pasted a strip of paper marked with an arbitrary scale (each degree of the scale I afterwards found to be 27 m.m.): the white surfaces used were crucible lids. A piece of glass rod resting on one of the cylinders, having the string of the movable disc attached to it, served as a windlass for raising or depressing it. To avoid the use of many ciphers I have taken 0·0001 grm. as the unit of measurement. In the following experiments column A denotes the amount of the colouring salt present, B the depth of the disc, and C the amount of the colouring salt thence derived by calculation. Standard solution, 35·2 of per-

* A Paper read before the Manchester Literary and Philosophica Society, April 23, 1878.

manganate of potash in 500 c.c. of water; depth of disk, 8·3.

A.	B.	C.
53	6·1	48
70	4·1	71

Experiments were made with still stronger solutions, but the differences were considerable.

Standard solution, 24 of permanganate of potash in 500 c.c. of water; depth of disc, 8·3.

A.	B.	C.
36	5·4	37
48	3·6	55
60	2·8	71

Still stronger solutions were used with this standard, but the discrepancies between the true and the calculated quantities were considerable. Standard solution, 5·8 in 500 c.c. of water; length of column, 8·3.

A.	B.	C.
7·2	5·7	8·4

Some experiments were made with solutions of permanganate of potash, using a shorter column for the standard solution. Standard solution, 2·4 in 214·6 c.c.; length of column, 3·8.

A.	B.	C.
3·6	2·2	4·1

An experiment was also tried with a still weaker solution. Standard solution, 1·4 in 214·6 c.c. of water; length of column, 3·8.

A.	B.	C.
2·4	2·6	2·1

Some experiments were also made by looking through the column of fluid at a white surface external to the cylinder. Standard solution, 12 in 500 c.c.; length of column, 8·4.

A.	B.	C.
14·4	6·5	15·5
28·8	3·1	32·5
16·8	5·3	19

I prepared a fresh standard solution of the permanganate and compared the last solution with it. The new standard was similar to the last in composition.

A.	B.	C.
16·8	5·7	17·6

Thus the result was somewhat more favourable with a newly prepared solution. I used the permanganate on account of its great tinctorial power; but it is a salt of considerable instability, especially in contact with organic matter. The water used in the experiments was obtained by distilling Manchester town's water from a copper still lined with tin, and condensing in a tin condenser. Now such water would not be wholly free from oxidisable matter; hence in a little while there will be a depreciation in the tint of the permanganate solution. If the tint be strong, the error arising from this cause might be neglected, but when the tint is feeble the error is appreciable. If the depreciation in tint in the two solutions compared were proportional to the depth of tint in each this source of error might be neglected; but inasmuch as the same quantity of water has been used in making each solution an equal amount of depreciation is introduced into each. Some of the foregoing experiments will be affected by this source of error. Small sources of error, which may be neglected when we deal with ponderable quantities, become of sufficient magnitude to vitiate results when we deal with traces.

For experiments with a yellow solution I took a solution of bichromate of potash. Standard solution, 10 in 500 c.c. of water; depth, 8·3.

A.	B.	C.
15	5·4	15·4
20	4·4	18·8
30	3·5	23·7
40	2·5	34·0
50	1·7	48·8
60	1·5	55·3

Still stronger solutions of the bichromate were compared with this standard, but the discrepancies were considerable. Some of the results also given in the last table are not very good; this more especially applies to the third and fourth results. On another occasion I repeated some of these experiments with the following results (standard solution same as last) :—

A.	B.	C.
30	3	27·6
40	3·2	37·7
50	1·6	51·8
60	1·4	59·3

Another series of experiments was made with the bichromate. Standard solution, 50 in 500 c.c., length of column, 8·3.

A.	B.	C.
60	6·7	62
70	5·3	78
80	4·5	92
90	4	104
100	3·7	112
110	3·4	122
120	3·2	130
130	3	138
140	2·8	148
150	2·6	160

In some of these determinations I felt considerable uncertainty at what depth equality of colour was obtained, and some of the results were likely to vary on repetition, In the table I put 5·3 as the depth after some hesitation. and with the intention to repeat the experiment on some future occasion. On repetition I made the depth of the disk 5·8, which would indicate the amount of the salt used as 71. In some other instances I felt uncertainty when working with a solution of the bichromate in determining equality of tint, so that whether the disk were elevated above or depressed below the position finally chosen the difference in colour was insensible. Perhaps with bright yellow colours the eye requires more experience to detect differences of shade than with colours not so glaring. Moreover, when there is a considerable difference between the quantities of the colouring salt in the two cylinders there is another difficulty to deal with. The colours to be compared differ not only in intensity but also in kind. A very dilute solution of bichromate gives a pale yellow with a slightly greenish shade, which passes, as the amount of salt is increased, into full yellow, orange-yellow, and finally orange. A similar observation holds with regard to several other colouring salts. Thus a very dilute solution of permanganate of potash is pink, passing, as the strength of the solution is increased, into crimson, and finally into violet. I also made some experiments with a blue solution. For this purpose I used an ammoniacal solution of sulphate of copper. The tinctorial power of this salt is not as great as I expected, and I made no experiments with a standard solution containing less than 150. On diluting 15 c.c. of an ammoniacal solution with sufficient water to make 500 c.c., I noticed after a little time that the solution was somewhat turbid. This was owing to the copper forming an insoluble compound, either hydrate or a sub-salt: further addition of ammonia was necessary to clarify the solution. Standard solution, 150 in 500; depth, 8·3.

A.	B.	C.
200	5·7	218
220	5·3	235
240	5·1	244
260	4·8	259
280	4·5	277
300	4·1	304
350	3·4	366
400	3·0	415
450	2·6	479

Some experiments were made with solutions of known strength, by sinking the disk to the depth assigned by

theory, to see if the given tint was attained, instead of moving the disk about until the tint was estimated to be the same and then reading off the result. A solution of bichromate of potash, containing 50 in 500 c.c., and depth 8·3, was used as a standard. Solutions containing 60, 70, 80, 90, gave similar tints at the calculated depths. Solutions containg 150, and increasing quantities, gave tints a little too deep at the calculated depths. Also a standard solution of permanganate of potash, containing 4·8 in 500 c.c. of water, and depth 8·3, was taken. Solutions containing 6 and 7·2 gave a similar tint at the depths assigned by the calculation. Solutions containing 9, 9·6, and higher quantities, gave tints a little too deep at the calculated depths.

Some of the foregoing results are fair approximations, and probably better results might be obtained with a more perfect form of apparatus than I employed. The surfaces used were not perfectly flat. Moreover, there was in some of the experiments the indecision arising from the coexistence of several distinct tints on the surface of the disk due to the formation of caustic curves. This I afterwards remedied by working behind a screen of lawn. The effect of this is to render the illumination of the disk much more uniform. Instead of a screen we might also use glass cylinders ground internally. Another difficulty is the indecision respecting the depth at which equality of colour takes place. The degree of indecision will be different for different persons, and I suppose represents want of sensibility and want of skill in detecting shades of colour. So far as it arises from want of skill it is likely to be diminished by more perfect experience with colours. It seems to me that it would be well to have some definite method for exercising the eye, or for testing one's skill in this respect. This might be done by having a series of cylinders filled with coloured solutions, the quantity of colouring matter increasing in arithmetical progression and endeavouring to arrange these solutions in their order, the arrangement being made according to the judgment of the tints. The various success attending such exercises would afford the experimenter some method for testing his skill from time to time. It would also show him under what conditions he could use neither this nor any other method of colorimetry; for when he has arrived at such a stage that he can perceive no difference of tint, notwithstanding an increase in the colouring matter, it seems as useless to try to do so as to use a balance of coarse sensibility to distinguish between two weights which are very nearly the same. By frequent exercise and concentrated attention I think the power of perception of difference of shade may be increased. If such a series of cylinders were taken containing, say, quantities of bichromate of potash, increasing from 1 to 30, the first members of the series would be easily arranged, towards the middle of the series the number of successful discriminations would diminish, and few would be able to detect differences in the higher members of the series; for an increment of the salt which produces a considerable difference in intensity when a small quantity of the salt is present produces a small difference when the quantity is large. This would follow from the approximate formula used, for—

$$\frac{dt}{dQ} = -\frac{c}{Q^2}$$

(t = depth, Q = quantity of colouring matter, c = constant). So that for a given small difference in the quantity the difference in the depth would be nearly proportional to the inverse square of the quantity. Solutions whose quantities of colouring matter are so similar as to be beyond discrimination by colorimetry may be again brought within its range by the following device:—In each of the two cylinders destroy by some appropriate method an equal quantity of the colouring matter; then their differences will be increased relatively to the quantities of colouring matter remaining, and may be sufficiently sensible to be estimated. When I suggested this method of colorimetry I had not seen the article on Light by Sir John Herschel in the "Encyclopædia Metropolitana." He there gives a probable formula for the intensity of light which has passed through an absorbing medium. His reasoning is as follows:—Let the intensity of the incident light be unity, and its intensity on emerging from a unit thickness of the medium, k; then its intensity at incidence on a second layer will be k_1, and its intensity at emergence k^2; hence, if t be the thickness of the medium the intensity well be finally k^t; and if the original intensity were a the final intensity would be ak^t. Now, light consists of several species: hence if the composition of the incident light be $a_I + a_{II} + a_{III} +$, &c., the composition of the emergent light will be $a_I k^t_I + a_{II} k^t_{II} + a_{III} k^t_{III}$, &c. If we use the letter I to denote incident light, T to denote transmitted light, and A absorbed light, Herschel's formula may be written more briefly as follows:—

$$\Sigma a = I,\ \Sigma a k^t = T.$$

k will a function of the quantity of colouring matter present in a unit thickness. If g be that quantity we may write $k = f(g)$, or if we expand $k = f(0) - f'(0)g +$ higher terms in g. Now g is very small. Let, then, the terms higher than the second be neglected. The first term will be the light transmitted when no colouring matter is present. If the colouring matter were dissolved in an absolutely transparent medium the first term would be unity. In practice water or some colourless medium is used; but the amount of light absorbed by a thin layer of pure water is very small, so that we shall make only a very small error in writing $f(0) = 1$. Hence $k = 1 - f'(0)g$. Substituting this value in Herschel's formula, and expanding, we have—

$$\Sigma a - \Sigma a f'(0) g t +, \&c.$$

Now, as g is very small, we may neglect terms beyond the two first (unless t be very large. Hence—

$$\Sigma a f'(0) g t = I - T = A.$$

If we assume the colour to be constant, A will be a constant term. Now, let Q denote the whole quantity of colouring matter in the cylinder, and L the whole length of the column, then—

$$g = \frac{Q}{L},$$

and the formula may be written—

$$\Sigma a f'(0) \frac{Q.t}{L} = A, \text{ or } Qt = \frac{A.L}{\Sigma a f'(0)} = \text{constant}.$$

ON THE

TESTING AND VALUATION OF GAS LIQUOR.

By T. H. DAVIS.

Gas liquor, as the majority of our readers are aware, is produced as a by-product in the manufacture of coal-gas. The crude gas, on leaving the retorts, having been deprived of its tar and portion of aqueous vapour in passing through the condensers, is conveyed through pipes to a "washer," or a "scrubber," the former being a vessel through which the gas bubbles, and the latter an upright tower filled with coke, over which a stream of water flows. In the passage of the gas, therefore, through either of these it is exposed to a considerable surface of water, and by this water the ammoniacal compounds, existing in the crude gas in a state of vapour, are absorbed. This water, containing salts of ammonia in solution, is allowed to mix with that condensed in the condensers, and the whole product is called gas water, gas liquor, ammonia water, or ammoniacal liquor, all these terms being synonymous.

The liquor thus formed has a specific gravity ranging from 1·005 to 1·070, or even 1·100, or, in other words, from 1° T. to 14° or 20° T., and in colour varying from straw colour, through various shades, to dark brown, some

samples being quite clear, and others more or less thick and turbid.

This is the liquor from which nearly the whole of our ammoniacal compounds are formed, and hence it must be considered as a valuable product, especially (as will be shown hereafter) that the compounds of ammonia which it contains in solution are in great part decomposed by mere boiling, and wholly if the liquor be mixed with lime previously. This liquor has been and now is in most all cases bought and sold on the basis of its specific gravity, or, in other words, on its degree Twaddle; but I hope to show the fallacy of this test—as has already been pointed out by my friend Mr. Geo. E. Davis, in a paper which he read before the British Association of Gas Managers this year—for surely the time has come when such empirical methods of testing and valuing such valuable products should no longer exist. The specific gravity of a liquor does, it is true, give a rough indication of its "strength;" that is, a liquor standing at 5° T. would be considered to be a more valuable one than one standing at 4° T., and less valuable than one which stands at 6° T.; but on examination of the table given below it will be seen that the degrees Twaddle should not be relied on, for one manufacturer may purchase a liquor standing at, say, 4° T., and another, at a higher price (one standing at 5° T.), and yet it is quite possible that the first may contain as much or more ammonia than the one at 5° The following table, which contains a few results taken from a great number, will show this in a clearer manner:—

	NH_3 *per cent.*			
3° T.	4° T.	5° T.	6° T.	7° T.
1·00	1·74	1·97	2·31	2·39
0·92	1·66	1·89	2·15	2·29
0·84	1·28	1·56	1·88	2·23
—	0·84	1·49	1·65	—

These percentages of ammonia were determined by a simple titration method which I have used for some years. I presume it is known to most of our readers, but for the benefit of those who may not be acquainted with it I have fully explained further on.

Some gas companies have, it is true, made an attempt to supersede the test by Twaddle by one which is more chemical, namely, by selling the liquor on the basis of the number of ounces of sulphuric acid required to neutralise a gallon of it, the results obtained being stated as a liquor of so many ounces strength. Thus, a liquor which required 10 ounces of acid to neutralise a gallon of it would be called a 10-ounce liquor, and so on; and it happens in many cases that the number of ounces required is about twice the number of degrees Twaddle: but this rule must not in any way be depended on, although some manufacturers base their calculations on it. I have given a few results from my note-book, expressing in the first column the degrees Twaddle, in the second column the "acid strength" or number of ounces of sulphuric acid required to neutralise a gallon of the liquor, and in the third column the degrees T multiplied by 2:—

Degs. T.	Ozs. Acid.	T. × 2.
5·25	11·38	10·50
4·80	10·06	9·58
5·00	8·91	10·08
5·50	10·11	11·08
4·80	7·29	9·58
6·10	10·20	12·20
5·70	8·78	11·36
6·00	11·50	12·00
6·00	9·53	12·00

Here we see at once, even in this rough method, the fallacy of the "degree Twaddle" as giving data for a fair and proper valuation of the liquor, for of course the ounces of acid required represent in a much fairer way its value than does the physical test of its specific gravity.

I think I may with safety say that as long as a manufacturer bases his calculations on the specific gravity test, he must never expect them to turn out true ones.

This test, then, receiving condemnation, what test shall be suggested to take its place? It must be one that can be easily done, without much trouble with apparatus, and one that can be performed quickly. Obviously, as the ammonia is the article the manufacturer desires to obtain, it should be also the basis of the test for valuation; that is, the liquor should be bought and sold on a sliding scale, at so much per ton for each per cent of ammonia it contains; then the manufacturer will know what he is buying, and the gas companies what they are selling; moreover, the manufacturer will also know the quantity of ammonia he is receiving to his stock, and can work his calculations as to the quantity of finished product he may expect, whether it be sulphate or chloride of ammonia, or liquor ammonia, with confidence and satisfaction.

Now, to determine the quantity of ammonia (as NH_3) in the liquor, my friend, Mr. G. E. Davis, recommends the distillation process, which consists of boiling a certain quantity of the liquor with lime in a flask arranged in a manner well known to us all, and passing the vapours into a known volume of standard acid, titrating back at the end of the experiment with standard soda. This we know to be a correct test, but, unfortunately, to be correct, it requires a considerable time, each test taking best part of an hour.

Before a contract is made between a manufacturer of ammoniacal products and a gas company this test should be carried through, so as to get at the actual quantity of ammonia to be obtained from the liquor; but I should not recommend a contract to be made embracing this test, for when each separate lot of liquor arrives at the ammonia works it would have to be subjected to that test in order to see that the delivery is of equal percentage to that stipulated for. Now in large works, as I know from personal experience, many separate lots of liquor from the same or different gas works will be arriving every day, each of which will of course require to be submitted to test; consequently, if the distillation process were to be adopted, the time occupied would be more than could be spared in a works laboratory.

As far as my experience shows me, the direct titration of liquor with normal sulphuric acid and calculation into ammonia would be a test sufficient to base a contract upon, and for the guidance of the manufacturer and for all practical purposes it may be looked upon as correct. Moreover, each test does not take five minutes, whereas, as I have before stated, the distillation process takes best part of an hour.

The titration method of testing is as follows:—Into a flask of about 300 c.c. capacity 10 c.c. of the sample to be tested are run in, and into this 15 c.c. of normal sulphuric acid. The contents of the flask are then raised to boiling over a naked flame, a few drops of litmus added and titrated back with normal soda. The number of c.c. of soda used are deducted from the 15 c.c. of acid employed, the result multiplied by 17, and divided by the specific gravity of the liquor. The result thus obtained represents the percentage of ammonia contained in the liquor. An example will make this clear:—10 c.c. of a liquor at 5° T. (sp. gr. = 1025), boiled with 15 c.c. normal acid, required 5 c.c. normal soda to neutralise it, consequently the sample contains 1·658 per cent NH_3; thus—

$$\frac{(15-5)\times 17}{10{\cdot}25} = 1{\cdot}658.$$

Now as to the valuation. Suppose we consider that 10s. per unit of NH_3 per ton to be a fair value, then the above sample would be worth $1{\cdot}66 \times 10{\cdot}5 = 17$s. 5d. per ton. Of course I do not wish to fix any price as the standard for valuation, that must be matter of arrangement. Such a system would induce gas managers to make the liquor as strong as possible, and ammonia manufacturers would do well if they were to refuse a contract for liquor containing less than 1 per cent of NH_3; for if below this—unless the liquor were given them—they would barely clear expenses of manufacture.

I trust this paper will cause other chemists who have had experience in the matter to express their views on the subject, for I cannot but think that all such would be glad if such rule-of-thumb methods as are now employed in this branch of chemical manufacture were abolished.

ON A NEW CHEMICAL TEST FOR CARBOLIC ACID, AND ITS USEFUL APPLICATIONS.*

By EDMUND W. DAVY, A.M., M.D.,
Professor of Forensic Medicine, Royal College of Surgeons, Ireland.

I HAD the honour, a short time ago, of bringing under the notice of the Academy, and of publishing in these *Proceedings*,† a new and exceedingly delicate chemical test for alcohol which I had at the time discovered; and I pointed out some practical applications which might be made of that test.

I subsequently directed attention to some further useful objects which may be attained by the employment of that alcoholic test, which latter have appeared in the *London Pharmaceutical Journal* for last year. I have recently discovered that the reagent which I employed for the detection of alcohol in the test referred to, viz., a solution of molybdic acid or molybdic anhydride in strong sulphuric acid, is a very delicate test likewise for carbolic, or as it is otherwise termed, phenic acid, a substance which is now one of considerable industrial importance, admitting as it does of so many useful applications, and one for which it is desirable to have a ready and at the same time a delicate test, for the detection of its presence under different circumstances. I have observed that when a drop or two of a dilute aqueous solution of carbolic acid is brought in contact with a few drops of the molybdic solution stated, there is immediately produced a light-yellow or yellowish-brown tint, which, passing to a maroon or reddish-brown, soon developes a beautiful purple colouration, which latter remains without further change for a considerable time. I should here observe that the application of a gentle heat will hasten the development of the purple reaction, though it will take place, but more slowly, at the ordinary temperature; and it is the production of this purple under the circumstances stated that constitutes the test for carbolic acid. The molybdic solution which I have chiefly used for this purpose is similar to the one I have employed for the detection of alcohol, and is made by dissolving, with the assistance of a gentle heat, one part of molybdic acid in ten parts by weight of pure and concentrated sulphuric acid. But the exact amount of molybdic acid dissolved appears to be a matter of indifference, as I have used other proportions with success, and in some recent experiments I found that a solution where there was only one part of molybdic acid in a hundred parts of sulphuric acid acted very well.

The mode of using this reagent is simply to add three or four drops of it to one or two of the liquid under examination, placed on any white porcelain or delf surface, when the effects already noticed will be produced, if carbolic acid is present. In carrying out this test, it will, however, be found the most convenient to use a small white porcelain capsule, furnished with a handle, which will admit of the application of heat when it may be desirable to hasten the reaction by that agent.

This test is one of great delicacy, for I have found that one small drop of an aqueous solution of carbolic acid, containing a thousandth part of its weight of that acid, and only absolutely about the one-seventy-thousandth part of a grain, when mixed with three or four drops of the molybdic solution, produced immediately the yellowish-brown effect, which, after a few minutes, passed into a very distinct and beautiful purple colouration, and this colour remained quite perceptible on the fourth day afterwards, though it had each day become fainter from exposure to the air and its consequent absorption of moisture. But this is not the limit of its delicacy, for I have detected by its means the carbolic acid in one drop of an aqueous solution five times more dilute, or where it contained the one-five-thousandth part of its weight of that acid, and in which there was only about the one-three-hundred-and-fifty-thousandth part of a grain present.

For the success of this test, it is necessary to attend to a few particulars, one of the most important being, that only a drop or two of the liquid under examination should be employed, for if much more be used the reagent will be diluted too much, and the characteristic reaction will not take place: for so great an effect has water on it, that even when the purple colouration is fully developed, the addition of that substance will cause either the colouration to disappear almost entirely, if the quantity of carbolic acid present be exceedingly minute, or if more abundant it first changes the purple to red, and then into a light reddish-brown, which becomes more and more faint on further dilution; but the addition of a few drops of the test solution, or even of strong sulphuric acid, again reproduces the purple, though of course fainter in its colour in proportion to the previous degree of dilution; thus showing that the mixture must be very strongly acid for the production and continuance of this purple effect. Another point to bear in mind is this, that when carbolic acid itself, and not an aqueous solution of it, is acted on by the molybdic reagent, a dark olive, quickly changing to a very deep blue, will be produced, but not the purple colouration; a cold saturated aqueous solution, however, of carbolic acid when so treated will yield the purple reaction; but even here there will be a tendency to develop the olive or blue effect, especially where the reagent employed contains a large proportion of molybdic acid; and I may observe that weaker solutions of carbolic acid give more satisfactory results, as the action appears to be too energetic when the acid itself or very strong solutions are employed.

The last precaution I wish to direct attention to, for the successful performance of the test, is this, that in applying heat to hasten the reaction, it should be limited to a gentle heat that the hand can bear when applied to the bottom of the capsule, this being about from 120° to 130° F., which is quite sufficient for this purpose, besides not exercising any destructive effect on the purple reaction; for I may observe that if the heat be raised even to 212° F., and continued for some time, the purple colouration will be destroyed and a blue produced; moreover, where organic matters are present along with the carbolic acid, many of them will likewise, when heated with the molybdic reagent to that latter temperature, or even much below it, develop a deep blue colour, which would mask more or less completely the purple effect of the carbolic acid. Consequently it is better in most cases to let the test act on the liquid at the ordinary temperature, though the reaction may be somewhat slower in developing itself.

I have made a number of comparative experiments with this test, and with the principal ones hitherto employed for the detection of carbolic acid, and I find, in point of delicacy, it seems only to be surpassed by the bromine test of Dr. Landolt, which depends on the circumstance that when an aqueous solution of bromine is brought in contact with carbolic acid, there is immediately formed the tribromo-phenol ($C_6H_3Br_3O$), a sparingly soluble white substance. But that test could not be successfully employed, at least immediately, in many cases, where the test just described might be still available, as, for example, in the case of different organic mixtures, where the presence of the tribromophenol formed would be concealed. It possesses likewise the great advantage of being apparently not interfered with, to any extent, by the presence of organic substances which mask or prevent the reactions of many of the other tests.

* A Paper read before the Royal Irish Academy, May 13, 1878
† *Proceedings*, Second Series, vol. ii., Science, p. 57

As to what is the exact nature or composition of the purple compound which is formed in carrying out the test, I have not yet been able to determine, owing to the difficulty of isolating it, or of obtaining it in a condition suitable for analysis; but I am inclined to think that it is not so much an oxidation product of carbolic acid as a deoxidation one of molybdic acid, and that it is a combination of one of the oxides of molybdenum, containing perhaps more oxygen than the blue compound which is formed where the molybdic reagent acts on alcohol and on some other substances; and one circumstance amongst others which seems to support this view is this, that I have failed to obtain by the action of other oxidising agents on carbolic acid a similar purple reaction.

Be this however as it may, I have satisfied myself that the purple compound formed in my test is a totally different substance from the red or crimson dye termed coralline, which is obtained by the united action of oxalic and sulphuric acids on carbolic acid, and is now largely used as a dyeing material; for the red colour of the latter substance is not affected by the caustic alkalies, and strong sulphuric acid changes it to a reddish yellow; whereas the purple developed in the new test is changed to green by caustic alkalies, and the purple again restored by strong sulphuric acid. I am, however, still engaged in this inquiry, and hope to be able yet to determine the exact nature of this purple compound, and of the changes which occur in this new reaction.

I shall now briefly notice some of the useful applications which may be made of this test. It is well known that carbolic acid is a powerful poison, and many instances are now on record where it has been the cause of death, such being generally either cases of suicide, or those where it has been accidentally taken by mistake for some other substance; as its odour and taste would render its administration, at least to an adult, by the assassin for the criminal destruction of life, a matter of some difficulty. The occurrence, however, from time to time of the cases referred to obviously renders it very desirable to be able readily to detect the presence of carbolic acid where it has been so used, either in the articles of food, drink, or medicine which have been taken, or in the ejecta or contents of the stomach; and this test affords a very easy and ready means of so doing, and of confirming the indications of other tests. According to my observations it will detect the presence of carbolic acid in different complex organic mixtures, even where the odour of that substance may be quite imperceptible; and I may observe, that the test of odour has hitherto been regarded as the most delicate for carbolic acid in such cases.

The great advantage this test possesses, especially for such applications, is this, that it does not appear to be much affected or interfered with, as already stated, by the presence of a number of organic substances which are likely to be present in such cases. Thus, as regards different articles of food—I have readily detected, by means of this test, the presence of carbolic acid when a small quantity of its aqueous solution had been added to the following articles, viz.: tea and coffee mixed with sugar and milk, porter,* ale, wine, a solution of Liebig's extract of meat and albumen; also where it had been added to blood, olive oil, gum, and soap—the very diverse substances in the articles mentioned not preventing the indications of the test.

It will also afford a ready means of detecting the elimination of carbolic acid in the urine, when that substance has been taken internally, for the compounds present in human urine naturally do not appear to affect to any extent this test. I may also observe, that with it I was at once able to detect the presence of carbolic acid naturally occurring in the urine of a cow, without any previous treatment of that secretion, and thus confirm the correctness of the statement as to the occurrence of that acid as a normal substance in the urinary secretion of that animal. This ready means of discovering carbolic acid in different animal fluids where it may exist will render this test useful to the physiologist and physician.

Another useful application of this test is, that it affords a very ready means of distinguishing creosote from carbolic acid, which is a matter of some commercial importance, much of which is sold as creosote being, as is well known to chemists and those in the drug trade, little else than carbolic acid; for those two substances, though obtained from different sources—true creosote being procured from the distillation of wood tar, whilst carbolic acid is got from that of coal tar—and though they differ likewise from each other in chemical composition, still so closely resemble each other in several of their properties, that the cheaper substance, impure carbolic acid, is in whole or in part frequently sold to the public for the dearer article creosote. If, however, we take a drop or two of each, and agitate them well with about a quarter of a fluid ounce of distilled water, and, having filtered the liquid, test a drop or two with the molybdic solution as already described, we will get in the case of pure creosote only a brown or reddish-brown reaction, which on standing or warming slightly becomes fainter, passing to a light-yellowish brown: whereas in the case of carbolic acid the brown passing to a maroon soon develops a more or less intense purple colour. This treatment will be sufficient to distinguish creosote from carbolic acid, and also to detect the presence of that acid in creosote, where it occurs in considerable proportion; for if, on the addition of the molybdic test solution, the mixture, instead of fading away to a light-yellowish brown on standing a short time, or on gently heating, passes to a reddish brown or to a maroon, it is an indication that carbolic acid is present. But I have found that the following very simple proceeding gave more satisfactory results, especially where small quantities of carbolic acid had been added to a large proportion of creosote. From five to ten drops of the liquid under examination are taken, and agitated briskly with about half an ounce of distilled water for a few minutes, so as to dissolve out the carbolic acid; the mixture is then filtered, and the filtrate is put into a little flask furnished with a close-fitting cork, through which passes a small glass tube about ten or twelve inches long, and bent above the cork at a little more than a right angle. The contents of the flask are then heated, and when the liquid boils the first portions which distil over will be found to present a more or less turbid appearance as they pass down the tube, from their containing minute globules of creosote; and a drop or two having been collected and tested with the molybdic reagent will give only the brown reaction of creosote: but by continuing the boiling, that substance will be more or less completely expelled, and then it will be found that a drop or two of the later portions of the liquid which distil over will give the purple reaction of carbolic acid. I may here observe that as it is only a drop or two of the distillate which is required each time for testing, it is not necessary to use any condensing arrangement, for the vapour passing through the tube itself is cooled sufficiently to furnish the small quantity required for each trial; but when it is desirable to collect in larger quantities the different portions of the distillation, a very small Liebig's condenser, in which the delivery tube can be inserted, will be found the most convenient arrangement to employ. In this way, by distillation, I was enabled to detect the presence of carbolic acid in creosote, where I had mixed

* As alcohol acts on the molybdic solution, producing an intense blue colouration, the presence of that substance, at least in any quantity, would mask more or less completely the reaction of carbolic acid. In examining, therefore, alcoholic liquors for that acid, it is better to submit them to distillation or separate the alcohol, and then to test the later portions of the distillate or the residue for carbolic acid; or what answers even still better in such cases is, to render the liquid alkaline by the addition of either caustic potash or soda, to combine with and fix the carbolic acid, and then distil; and when all the spirit has been removed, to add diluted sulphuric acid to slight acid reaction to liberate the carbolic acid and after this distil again, when that acid will come over unmixed with any spirit, and give its characteristic reaction.

only one part of the former with a hundred parts of the latter, which would be more than sufficiently delicate for any case likely to occur in commerce; for where such adulteration was practised, it is probable that a much larger proportion of carbolic acid would be used, to render the fraud sufficiently remunerative. In the same way, I have readily succeeded in detecting the presence of carbolic acid in oil of cloves, where I had purposely added a small proportion of that acid, as it is stated that this very objectionable fraud is occasionally practised, of adulterating the essential oil of cloves with carbolic acid.

The few applications that I have referred to are, I I should trust, sufficient to indicate the practical utility of this test; which, being at the same time so simple and easily performed, will, I have no doubt, be found useful for the objects stated, as well as for others to which it may be applied.

REMARKS ON THE ESTIMATION OF SULPHATE OF LIME IN BEER.

By H. M. WILSON.

The precipitation of sulphuric acid in the direct way—that is, by boiling a portion of the sample, adding hydrochloric acid and chloride of barium was found to yield results, which were lower than was anticipated, and which were further of a discordant nature. Three samples were treated in the following way:—

100 c.c. in each case was boiled with about 5 c.c. of hydrochloric acid; chloride of barium was then added. The mixture was again boiled, allowed to settle, and filtered. A slimy precipitate was thrown down, together with sulphate of barium, the effect of which was to protract very much the filtration of the precipitates.

The precipitates, after being well washed, were dried and ignited, whereupon they weighed respectively (calling them A, B, C)—

A.	B.	C.
0·077 grm.	0·064 grm.	0·060 grm.

Samples B and C were now treated in a different way: 100 c.c. of each was evaporated to dryness, after the addition of about 0·5 grm. of nitrate of potassium, and gently ignited over a Bunsen flame. The resulting carbon was filtered off, and the now colourless filtrate strongly acidified with hydrochloric acid, boiled, and precipitated with chloride of barium.

The weight of the sulphate of barium was—

B.	C.
0·093 grm.	0·092 grm.

These weights, calculated into grains per gallon, give 37·80 in the one case, and 37·59 in the other, whereas, by the first method, we have 25·9 grs. in the one and 24·50 in the other.

From this it would appear that the organic matter in beer interferes with the precipitation of sulphuric acid (in addition to its reducing action), and that the first method employed is not applicable in the case of beer, although it is recommended in the case of urine. The second method yielded perfectly homogeneous results on repetition.

29, Lansdowne-road.

ON THE CHEMICAL ANALYSIS OF STEEL.

By SERGIUS KERN, M.E., St. Petersburg.

The author published, some time ago (Chem. News, vol. xxxvii., p. 964), a note on some results of his analysis of various steels, where it is shown that it is desirable that the mechanical test should precede the chemical test, as, at the present day, the searching out for 0·01 or 0·02 per cent of carbon, more or less in the steel specimen, seems to be the chief work of many metallurgists. Many think that steel containing 0·30 per cent of carbon distinctly differs from steel containing 0·29 per cent of carbon. In fact, at present, there is too much chemistry in metallurgy. The author had an opportunity of analysing six specimens of steel plates, which were rejected, as they gave inferior results on being mechanically tested. Supposing that this arose from the inferiority of the steel, analyses of these specimens were executed which, however, showed the contrary—the steels chemically were all very fine specimens of Siemens-Martin metal, and were, after rolling, annealed.

A. *Mechanical Tests of the Samples.*

Nos.	Breaking weight. Tons per square inch.	Elongation. Per cent.
1	26·55	14·24
2	25·05	14·92
3	24·01	15·05
4	23·74	13·08
5	25·52	12·60
6	25·42	13·40

The length of the specimen was 8 inches.

B. *Chemical Analyses of the Samples.*

Nos.	Carbon.	Manganese.	Silicon.	S.	Ph.
1	0·22	0·08	0·01	0·01	0·02
2	0·18	0·06	traces	0·02	0·01
3	0·14	0·05	—	traces	0·04
4	0·25	0·15	0·02	0·01	0·01
5	0·15	0·14	0·01	0·03	0·02
6	0·20	0·10	traces	0·01	traces

It appeared, as it was ascertained afterwards, that the plates could not stand the required mechanical tests, owing only to the inferior workmanship.

EXPERIMENTAL DETERMINATION OF THE VELOCITY OF LIGHT.*

By ALBERT A. MICHELSON,
Ensign United States Navy, Annapolis.

This paper was considered one of the most important before the section, but it is impossible to present a proper idea of it without the diagrams accompanying it. But three scientists, Foucault, Fizeau, and, more recently, Cornu, Mr. Michelson said, have sought to ascertain accurately the distance of the sun from the earth. Foucault used the method known as that of "Wheatstone's Revolving Mirror," the application of which was first suggested by Arago. Fizeau and Cornu both used another method, known as that of the "toothed wheel." In Foucault's experiments the distance traversed by the light was 20 metres. The result obtained by him was 185,200 miles per second. Cornu's stations were about 14 miles apart. The result obtained by him was 186,600 miles, which exceeds the former by 1400 miles. The objection to Foucault's method is that the displacement, which enters directly in the formula, is very small, and therefore difficult to measure accurately. The objection to Fizeau's is that the time of total disappearance of the light was necessarily uncertain. The object of Mr. Michelson's experiments is to increase the displacement in the first method. This can be done in several ways: (1) By increasing the speed of the mirror; (2) by increasing the distance between the two mirrors; (3) by increasing the radius of measurement, *i.e.*, the distant from the revolving mirror to the scale. In Foucault's experiments the speed of the mirror was four hundred turns per second; the

* Read before the American Association for the Advancement of Science, Section A.

radius of measurement was about one metre, and the distance between the mirrors was about ten metres. The displacement obtained was about 0·8 millimetres. In Mr. Michelson's experiments the speed of the mirror was but one hundred and thirty turns per second, but the radius of measurement was from 15 to 30 feet, and the distance between the mirrors was about 500 feet. The displacement obtained varied from 0·3 of an inch to 0·63 of an inch, or about twenty times that obtained by Foucault. With a greater distance between the mirrors and a better apparatus he expected to obtain a displacement of 2 or 3 inches and to measure it to within one-thousandth part of an inch. Tables of observation of the velocity of light in air were given by Mr. Michelson, the mean result being 186,508 miles per second.

CORRESPONDENCE.

TELEPHONE RELAY.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxxviii., p. 138, I notice a counter-statement from Mr. E. J. Houston, of Philadelphia, regarding my assertion that the telephone relay which he has brought out was devised by me over a year ago. He says:—

"Now it would appear from a description of this instrument in the *Telegraphic Journal* of July 1, 1877, that Mr. Edison called his invention a pressure relay, and states that it is intended to be used in connection with his speaking telegraph. So far as I can hear this speaking telegraph is not an articulating telephone but a species of harmonic telegraph, in which vibrating pulses of electricity are employed in a manner somewhat similar to the system of Gray. Nowhere in this article, or indeed elsewhere that I can find, does Mr. Edison claim that his invention can be applied to relaying of rapidly varying currents of the articulating telephone."

I quote from the article in the *Telegraphic Journal* of July 1, 1877, to which he refers—

". . . For instance, if a weak current circulates upon the line in which the relay magnet is inserted the attraction for the armature will be small; consequently a weak current will circulate within the second current; and, on the contrary, if the current in the first circuit be strong the pressure upon the plumbago discs will be increased, and in proportion will the current in the second circuit be increased, no adjustment is ever required. It is probably the only device yet invented which will allow of the translation of signals of *variable strengths* from one circuit into another by the use of batteries in the ordinary manner. The apparatus was designed by Mr. Edison for repeating *acoustical vibrations* of *variable strengths* in his speaking telephone."

This apparatus is used now and was used at the date named to do exactly what the article says it was intended for, and it was seen in operation by hundreds of persons during the year 1877. The statement that a "speaking telegraph" is not an articulating telephone is a pretty fine distinction without a difference. Change of form and name appears to be an easy and favourite method now-a-days of making discoveries and inventions.—I am, &c.,

THOMAS A. EDISON.

Menlo Park, N. J., U.S.A.,
Sept. 29, 1878.

CHEMISTRY IN THE UNITED STATES.

To the Editor of the Chemical News.

SIR,—I do not think it improper for me to caution chemical students and experienced chemists, through the columns of a journal so widely distributed as the CHEMICAL NEWS, against coming to this country in search of employment. I can assure them that they can bring their wares to no worse market. The reasons are obvious.

First. For every vacancy that occurs, ten well qualified capable chemists, Americans, present themselves. This is the ordinary rule; and,

Second. Business is so depressed and dull here just now that now, of all times, it is next to impossible for a good chemist to find a place, whether he be a foreigner or native born.

Only yesterday I told a competent chemist, a pupil of Liebig, Wöhler, and Bolley, who spoke English fluently, and had studied chemistry in *this* country, that it was of no use for me to add his name to the list on my desk of chemists wanting places.

Our technological schools and our colleges are turning out ten times as many chemists, engineers, and geologists as we need, and those foreign scientists who come to this country in hopes of remunerative employment will be sadly disappointed.—I am, &c.,

J. M. MERRICK.

Laboratory, 59, Broad Street, Boston, U.S.A.,
September 27, 1878.

"SILAONITE."

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxxviii., p. 109, there appeared, among other notes of work by students of the University of Virginia, the results of an examination by Mr. H. D. Bruns, of New Orleans, of "Silaonite," a mineral described as a new species by Prof. V. Fernandez, of Guanajuato, Mexico. Mr. Bruns found this to be a mixture and not a true species. Three days ago, on my return home from an absence of a couple of weeks, I found a letter from Senor Fernandez, dated June 18, in which he informs me that he had ascertained his supposed species to be but a mixture. His letter had been addressed to me to the care of Mr. E. S. Dana, of New Haven, who has been in Europe during a large part of the summer; hence, probably, the long delay in its reaching me.—I am, &c.,

J. W. MALLET.

University of Virginia,
Sept. 30, 1878.

On Anthra-rufin, a New Bioxy-anthraquinon from Meta-oxy-benzoic Acid.—E. Schunck and H. Römer.—Anthrarufin, $C_{14}H_8O_4$, is almost insoluble in water, but sparingly soluble, with a yellow colour, in alcohol, whence it crystallises in yellow regular quadratic tables, decidedly iridescent. In glacial acetic acid it dissolves sparingly, the solution having a faint green fluorescence. In benzol it is freely soluble, but less readily in ether and bisulphide of carbon. In chloroform it dissolves with a yellow colour. All these solutions display no absorption-bands, but merely a darkening, chiefly in the highest portion of the spectrum. Soluble in concentrated sulphuric acid. Strong solutions appear of a cherry-red by transmitted light, but by reflected light they display a strong crimson fluorescence. Dilute solutions assume a splendid crimson colour. Very dilute solutions show two very well-defined absorption-bands, and a third one less distinct. One part of the colour in 10 million parts of sulphuric acid appears of a crimson colour in a stratum of 1 inch in depth. The absorption-bands are still visible when the solution is almost as colourless as water. Anthrarufin does not dye fibres mordanted with alumina or with iron. It yields crimson lakes with lime and baryta, but is not precipitated by alcoholic acetate of lead. If treated with potassa to fusion there is formed a deep-blue mass of a metallic lustre, which dissolves in water with a violet-blue colour. —*Ber. der Deut. Chem. Gesellschaft zu Berlin.*

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

AUGUST, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·000	0·008	0·105	0·046	17·00	6·880	0·612	0·94	1·000	12·6	3·00
West Middlesex	Clear	0·000	0·008	0·105	0·050	17·60	7·400	0·576	0·94	0·966	12·6	2·80
Southwark and Vauxhall	Clear	0·000	0·008	0·096	0·053	17·30	7·700	0·612	0·94	0·930	12·6	3·00
Chelsea	Clear	0·000	0·007	0·090	0·035	16·70	7·590	0·540	0·94	0·930	12·6	2·80
Lambeth	Clear	0·000	0·008	0·129	0·050	19·10	7·950	0·504	0·94	1·030	13·2	3·00
Other Companies.												
Kent	Clear	0·000	0·002	0·435	0·003	29·10	11·530	1·153	1·73	4·036	20·5	6·00
New River	Clear	0·000	0·006	0·135	0·017	17·40	7·750	0·648	1·01	1·130	13·7	3·30
East London	Clear	0·000	0·007	0·090	0·039	18·60	7·950	0·756	1·16	1·200	13·2	3·00

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 14, September 14, 1878.

Remarks on the Phonograph and the Telephone.—M. Bouillaud.—The author discusses the question whether the phonograph repeats words on a principle similar to that of the echo. He asserts that as regards force, tone, speed, and quality, the words of phonographic origin differ notably from those which have been uttered, which is not the case with words repeated by an echo. As to the telephone, he expresses doubts as to the part played by the electro-magnetic machine.

Industrial Utilisation of Solar Heat.—A. Mouchot.—The author describes several successful experiments made at the Exhibition on the conversion of solar heat into motive power.

Minima Produced in a Calorific Spectrum by the Refractory Apparatus and the Lamp which serve for the Formation of the Spectrum.—MM. Aymonet and Maquenne.—Not suitable for abstraction.

Rotatory Power of Quartz and its Variation with Temperature.—J. Joubert.—Quartz, by its rotatory power, constitutes a thermometer of extreme sensibility, fulfilling the essential condition of every thermometer, comparability. When once the apparatus is fitted up it is merely needful, in order to find a temperature, to read off an angle, and refer to a table calculated once for all. It may therefore be hoped that science, and even industry, may find in this new thermometer an instrument comparable to the mercurial thermometer for the simplicity of its use and the certainty of its indications. The author's experiments extend from −20° to +840°, or perhaps 1500°.

Presence of Isopropylic, Normal Butylic, and Secondary Amylic Alcohols in the Oils and Alcohols of Potatoes.—M. Rabuteau.—The author gives in a table the nature, the boiling-points, and mean quantities of the products found in a litre of potato-oil.

Biedermann's Central-blatt, July, 1878.

Quantity of Ammonia in the Sea-Water, and in the Salt Lagoons near Montpellier.—Prof. M. A. Andoynaud.—The author concludes from his experiments that neither the sea-water nor the water of the salt lagoons contain volatile ammoniacal salts.

Drinking-Water of Friesing.—L. Aubry.—The author points out that a decrease of the total solids in water may proceed, *pari passu*, with increasing contamination, certain of the mineral salts present being precipitated by the organic impurities. Hence a determination of total solids is by no means sufficient to warrant an opinion on the quality of a water.

Mucoid Algæ in Drinking-Water, and the Application of Tannin for the Purification of Waters thus Contaminated.—Dr. H. Kämmerer and Dr. H. Hager.—The first-mentioned author proposes tannin as a reagent for water analysis. He considers it as a group-test for a great number of bodies of animal origin, such especially as pass most readily into putrefaction, such as the albuminoids, glue, &c., which in his opinion readily penetrate into subsoil water, pollute it, and, according to modern views, must be regarded as especially dangerous. He arrives at the following conclusions:—1. The occurrence of glue in the subsoil waters can no longer be doubted, and in some cases it is even found in relatively considerable quantity. 2. Tannin is a suitable reagent for the detection of glue and kindred substances, and its application should never be omitted in the analysis of water from a sanitary point of view. 3. The presence of salts and certain other compounds may delay the precipitation of tannin. The decision as to the result of this reaction should therefore not be given until twenty-four hours have elapsed. 4. Any water which is rendered turbid by tannin to a marked extent must be regarded as dangerous. As far as the decision is concerned it is indifferent whether a precipitate appears immediately or not until the lapse of some time. Hager refers to the above communication, and especially to Kämmerer's assertion of the presence of glue in subsoil waters, as inferred from the behaviour of the water with glue. He narrates that in the year 1866, at the time of the prevalence of Asiatic cholera in Berlin, he lived in one of the districts most severely visited by this disease, and was thus induced to examine the spring-

waters. He found that a bad water could be most simply and conveniently rendered potable by the addition of a solution of tannin, consisting of 2 parts tannin, 1 part sugar, 3 parts water, and 5 parts alcohol. The water from a spring in the court of No. 13, Alte Jakob-strasse, near which a churchyard is said to have formerly existed, was rarely clear, and contained ammonia and nitrates in abundance. On the addition of tannin, though often not until after the lapse of ten or fifteen minutes, it yielded flocculent precipitates which had not always the same volume. The author endeavoured to ascertain the cause of this diversity. Water drawn early in the morning almost invariably yielded, on the addition of tannin, a plentiful precipitate. This, when collected and mixed with alcoholic ether, gave a solution which on standing deposited a mucous flocculent sediment containing mere traces of lime, and which, when dried and carbonised, gave proofs of animal origin, but never of the presence of glue. The water drawn in the afternoon, after the well had been used by the numerous inhabitants of the house, appeared scarcely susceptible to the action of tannin, but after the lapse of two hours a copious precipitate was determined. The assumption that the tannin precipitate owed its origin to Algæ existing in the water, that the remains of the dead or dying Algæ were immediately precipitated, whilst the still living Algæ were first killed and then precipitated, gave a sufficient explanation of the behaviour of the water drawn at different times. The author does not conceal that he at first was inclined to admit the presence of glue in the water. Microscopic observation soon convinced him that Algæ were really present. The water drawn in the morning was rich in living and dead Algæ, whilst that obtained in the afternoon contained but few, though after it had been allowed to stand for a few hours they were formed in indefinite numbers. The Algæ were of various kinds. Some had an elliptical form (glocotheke and apanotheke), whilst others, and the most numerous, belonged to the *Oscillaria* (Vibriones).

Studies on Basalt.—Dr. J. Hanamann.—Basaltic soils are porous, warm, and moist, and even the subsoil is readily pervious to air and moisture. Upon no other mountain formation do we find so varied and luxuriant a vegetation. Basaltic tufa, basaltic wacke, and amygdaloid are still more fruitful.

Absorptive Power of Arable Land.—Prof. J. M. Van Bemmelen.—The chemical absorptive power of a soil treated with hydrochloric acid is not restored by the addition of soda or carbonate of lime; the increase of the absorption after such treatment (power of taking potassium from the chloride of potassium) must be referred to a decomposition of the chloride of potassium with the carbonates remaining in the soil; carbonate of potash is formed, which is absorbed by the soil as such.

Detection of the Principal Adulterants in Ground Coffee.—C. Krauch.—Coffee is distinguished by its high percentage of fatty matter (minimum 11 per cent as against 1·15 per cent of chicory) and by its low proportion of sugar (0·2 per cent as against 22 per cent in chicory).

August, 1878.

Examination of a Number of Spring Waters of the Town of Münster.—Dr. J. König.—The author remarks, "The potable waters of our provincial capital are among the worst known, and are occasionally so bad that many a farmer would hesitate to give them to his cattle. The analyses appended show merely total mineral residues, organic matter, chlorine, nitric acid, and ammonia, the quantity of the last-mentioned impurity being in many cases expressed merely by such terms as "distinct," "much," "too much" (!) Dr. König adds—"A determination of the proportion of oxygen was executed in various samples in order to throw light upon their quality, but has hitherto led to no positive results, its quantity appearing to bear no fixed relation to the goodness of the water. Both in very bad and in good waters it has varied during the past summer from 3 to 4·5 c.c. per litre. The spring-water at the Münster experimental station contained, in the spring of 1877, from 6 to 6·5 c.c. oxygen per litre; in July and August, 3 to 4·5; and in October and November, from 8 to 10."

Distribution of Salts in the Soil.—H. Pellet.—Referring to Joulie's classification of salts as ascending and descending, according as they rise or sink in the soil, the author finds that the majority of salts are ascending, and that those which descend are principally deliquescent, such as carbonate of potash, chloride of calcium, but not nitrate of lime.

Action of Solutions of Gypsum upon Arable Soils.—W. Kalmann and F. Böcker.—The soil absorbs more lime from concentrated than from dilute solutions of gypsum. On treating a soil with gypsum solution more magnesia and alkalies are dissolved than if distilled water was employed.

Reimann's Färber Zeitung,
No. 37, 1878.

A certain Prof. J., who on a former occasion detected arsenic in green lamp-shades, has not discovered the same poison, in the state of Schweinfurth green, in the *inside* of pasteboard cigar-holders.

At the recent meeting of the "Association for Protecting the Interests of Chemical Industry in Germany," the question of legislative prohibition of the use of poisonous colours was debated at length. The conclusion reached was that no colour should be denounced as poisonous, or placed under legal restrictions, until a commission of qualified chemists and physiologists had declared its applications injurious to health.

A New Colouring-Matter.—The well-known firm of dye-manufacturers, Meister, Lucius, and Brüning, of Höchst, have brought out a series of colours for the production of ponceau in yellower and redder shades, and also of claret upon woollens. These colouring-matters are produced from the sulpho-naphthylates by treatment with the diazo-compounds of benzol and its homologues, as well as of naphthalin. These colours can be used for dyeing with the mere addition of sulphuric acid, but the shades are not so bright as when a solution of tin is employed. To 100 kilos. of wool, placed in a wooden or well-tinned dye-bath, are added 2½ kilos. tartar, and boiled. The colour, previously dissolved, is added as may be required, and 5 kilos. of tin-composition are gradually added. The wool is then taken out, cooled, and washed. The tin-composition is made by mixing 3 parts hydrochloric acid, 1 part nitric acid, and 1 part water, and dissolving ½ kilo. tin in 3 kilos. of this acid liquid.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 987.

THE NOXIOUS VAPOURS COMMISSION. THE WORK OF THE FUTURE.

THE recommendations with regard to future legislation on the subject of noxious vapours appended to the Report of the Commissioners seem to be most reasonable and judicious, and if properly carried out by Government will no doubt work an important and beneficial change in the condition of those districts in which chemical manufactures are carried on. The recommendations of Scientific Commissions are not, however, always acted upon; those made, for instance, nearly three years ago by the Commission on Scientific Instruction have hitherto remained a dead letter. Let us hope that the same neglect will not be allowed to render nugatory the labours of the Commission on Noxious Vapours.

One of the first recommendations made by the Commission was with regard to coke-ovens. Bearing in mind the evidence of Dr. Angus Smith with regard to the particles of soot deposited by coal-smoke acting as carriers of sulphurous acid, we must not be surprised to hear that coke-ovens are looked upon as an intolerable nuisance wherever they are established. The evidence of Mr. Isaac Lowthian Bell on this subject is most valuable from its suggestiveness. He tells us that in the counties of Durham and Northumberland six million tons of coal are annually converted into coke, giving off at least two million tons of volatile matter. Where the beehive form of oven is used vast volumes of thick smoke are given off at a height of from 10 to 15 feet above the ground, the destructive effects of which, although not so extensive as those caused by alkali and copper works, are still very considerable, every blade of glass and every leaf being destroyed for several hundred yards around the works. With regard to such nuisances Mr. Bell takes very high ground. He told the Commission emphatically that he held it "to be a duty which every manufacturer owed to the neighbourhood that he should carry on the manufacture with the least possible destruction of property and with the least annoyance." Such sentiments as these merit the applause of every right-minded man, and form a strong contrast to the pettiness of spirit manifested by certain of the witnesses examined. That coke-ovens can be carried on without subjecting their neighbourhood to damage or even nuisance has been amply proved by Mr. Bell himself. By proper appliances the heat and smoke, instead of being allowed to escape, are utilised by being carried under the boilers, thus effecting a large saving in fuel; and manufacturers have found it so much to their interest to adopt this plan that already more than half the coke-ovens in the above districts have been converted, and a large number of others are in course of alteration. The yield of coke is not affected in any way by the change; fuel is economised; and the sulphurous vapours, which ultimately make their escape from a tall chimney, are so diluted as to inflict little or no injury on either plants or animals.

According to the recommendations of the Commmision all coke-ovens should be placed under inspection, and that all those which are erected after the proposed additions are made to the Alkali Acts should be required to adopt "the best practicable means" of preventing the escape of black smoke and of diluting sulphur compounds. Further, in case complaints should be made against existing ovens, they should be compelled to adopt "the best practicable means" of abating the nuisance within three years.

The next offenders which engaged the attention of the Commission were the Northwich salt works. During the process of evaporating the brine large volumes of dense smoke, charged more or less with sulphurous acid and saline particles are evolved. Dr. Richardson described the damage to vegetable life as extending to a distance of a mile and half from the works. The rural sanitary authorities of Northwich have again and again taken proceedings against salt manufacturers, but the only result seems to be the payment of heavy fines and no improvement as regards the quantity of smoke emitted. One manufacturer declared that he would go on paying fines until he was ruined before he would abate the nuisance, a statement that must be taken with the usual grain of his special manufacture. The general opinion of other witnesses seemed to be that it was a mere question of proper stoking, and that the nuisance might with care be greatly diminished if not entirely abated. It was ultimately recommended that salt works should be placed under inspection for the present, but that no further legislation should be applied to them yet.

Chemical manure works are also to adopt "the best practicable means" of preventing escapes of sulphuretted hydrogen.

The cement works about Northfleet and Greenhithe seem to be not only a nuisance to the inhabitants of this part of the world, but at times they emit such dense masses of smoke that the navigation of the Thames is interfered with. The Hoffmann kiln, in which complete combustion is effected, seems to be the proper remedy in this case. Professor Odling in his evidence described this kiln as effecting a large economy in fuel; cement works are therefore to be placed in the same category as salt works and coke-ovens.

The Lambeth Potteries were next brought before the Commission. Here again the evidence was most conflicting, the Archbishop of Canterbury declaring that the hydrochloric acid fumes from Mr. Doulton's tall chimneys corroded and otherwise injured the Archiepiscopal plate, steel, books, trees, and buildings, while so high an authority as Professor Odling declared that there is no real injury done by salt-glazing to stone, vegetation, or human beings. The number of salt-glazing kilns in Lambeth has been reduced from 83 to 34 during the last twenty-five years, and much less salt is used than formerly. Attempts have been made by Mr. Doulton at St. Helens to condense the hydrochloric acid fumes, and Dr. Angus Smith and Mr. Fletcher (one of his sub-inspectors) are of opinion that the experiments are sufficiently successful to justify legislation compelling potters to condense. The Commission thought otherwise, and contented themselves with recommending potteries for inspection.

Gold refiners, lead smelters, and glass makers escape interference for the present.

"Dry" copper works are also to be placed under inspection.

The system of inspection and the appointment of inspectors, whether by the central or local authority, took up a great deal of the time of the Commission. The question is apparently one of extreme difficulty.

The alkali manufacturers recommend almost unanimously that the inspectors, by whomsoever appointed and paid, should be wholly independent of local control, and removed as far as possible from local influence. They also unite in approving of the action of the inspectors up to the present, admit the great benefits derived from it, both in suggesting improvements and in other ways. They also recommend an increase in the number of inspectors. In this latter recommendation the landowners agree with them, but ask that they should enforce the law more strictly than they have hitherto done. The manufacturers whose works it is intended to place under inspection do not seem to make any very serious objection, always excepting Mr. Hussey Vivian, who condemns inspection in any form and looks on factories as fortresses. They ask, however, that the inspectors be made independent of the local authorities. The only witnesses that advocated local as opposed to

central control were all more or less connected with the Local Government Board.

The manufacturers favour central control on very strong grounds. The local sanitary officer, they are of opinion, however competent he may be for the ordinary work of sanitary inspection, would be certain rarely to possess the necessary scientific and chemical knowledge for the performance of his duties under the Alkali Acts, in which case his action could hardly fail to be partial and vexatious; besides which, he would necessarily fail in being able to make suggestions for those improvements which the knowledge and experience of the present race of inspectors enable them to make for the benefit alike of the manufacturers and the public. Again, the recommendations made with regard to the inspection of fresh descriptions of works should, argue the manufacturers, be looked on as merely temporary. The inspectors should make periodical observations on the progressive improvements in condensation, which would from time to time enable the Legislature to apply to each kind of vapour a compulsory standard of escape. This, of course, pre-supposes the formation of a complete staff of efficient inspectors working harmoniously with each other under a properly qualified head, a state of things which would be wholly unattainable if the local system were adopted. The works in which these industries are carried on are not very numerous, and are generally grouped together in a few districts, so that the staff would consist of a small number of highly qualified individuals.

The landowners also favour the central system. With the few exceptions we have named, there seemed to be a general consensus of opinion on this point. In any case it is a matter of fact patent to all that as a rule the local authorities do not do their duty, the evidence on this point being particularly clear and distinct. For example, the only town along the banks of the coaly Tyne in which the provisions of the Smoke Nuisance Act are carried on by the Local Board is Gateshead, and in every other town in the district the law is entirely disregarded, except in the case of Sir William Armstrong, who sets his neighbours a good example by complying voluntarily with the provisions of the Act. Local Boards are only too loath to do anything which may discourage the establishment and extension of manufactures which contribute to the local prosperity.

A plan was suggested by which the inspectors would be appointed and paid by the county, but this was objected to, large portions of most counties being unaffected by manufactures there would probably be an outcry and a refusal to levy the necessary rates.

Another suggestion was that the Local Government Board should form groups of districts including the works emitting the noxious vapours and the localities affected by them. But objections were raised to this also; in fact, the virtues of the central system seem so apparent that we venture to assert that it must ultimately be adopted. Its uniformity, the equal standard of inspection, the accumulation of the experience of a number of highly qualified men in one central point, the wholesome emulation amongst the inspectors (each to make his district the most perfect), and last, but by no means least, the readiness with which manufacturers and landowners alike seem willing to co-operate with the inspectors under the central system, drives all other plans from the field.

The Commissioners, however, were divided in opinion on the primary question. They were unanimous in holding that the inspection cannot possibly be entrusted to the local sanitary authorities for the reasons already given, but they could not agree with regard to the merits of the central system and the group system; they are obliged, therefore, to leave the matter in the hands of the Government.

Their recommendations with regard to the appointment and duties of inspectors are that a head inspector should be appointed by the Local Government Board at a liberal salary, so as to secure the undivided services of a thoroughly competent man, who should be provided with a proper laboratory and assistants. He should examine, correlate, and average the sub-inspectors' reports, and satisfy himself by personal visits that "best practicable means" were being adopted to reduce to a minimum the escape of noxious vapours.

In taking leave of this very interesting Report, by far the most important to our readers that has appeared for some years, we cannot refrain from congratulating all concerned on the successful end of their labours, and from expressing a wish that their very judicious recommendations will speedily be adopted.

ON A NEW METAL—PHILIPPIUM.

By M. MARC DELAFONTAINE.

The researches in which I have been engaged for more than two years on the Samarskite earths* have led to the discovery in that mineral of a fourth earth belonging to the yttria group. This mineral is yellow like terbia, but its equivalent is lower. My researches on the gadolinite metals had formerly led me to a similar conclusion, which, however, I was prevented from establishing on account of the destruction of my laboratory in the great fire of Chicago.

As this new earth occupies an intermediate position as to colour and weight between yttria and terbia,† it might naturally be supposed that it is after all only a mixture of these two bodies. But the numerous and varied experiments that I have made convince me that such is not the case. Further, profiting by the examination which M. Soret has just made of the absorption-spectrum of erbium, and also by his recent study of the spectra of other earthy metals,‡ I have been enabled to confirm the correctness of my former conclusions.

I therefore announce definitely the discovery of the oxide of a new metal, to which I have given the name of Philippium (Pp) in honour of my benefactor M. Philippe Plantamour, of Geneva, the friend and pupil of Berzelius. I may remark, in passing, that this name adapts itself perfectly to the ordinary terminations of chemistry, not only in the French, but in the English, German, and Swedish languages. Thus the earth will be called Philippine in France, Philippia in England, Philipirde in Germany, Philipjord in Sweden.

The following are its distinctive characteristics:—Admitting provisionally that philippia is a protoxide, its approximate equivalent is comprised between 90 and 95. I cannot be more precise at present. The metals of the cerite and gladolinite groups are like fatty bodies or alcohols of the ordinary series; they are recognised easily in the pure state, but they are separated with great difficulty, and this difficulty is increased when they are from five to seven in number.

We have yet no means of knowing if philippia is completely free from yttria, although it is easy to reduce to a great extent the proportion of the latter. Erbia and philippia are mutually carried down and held by each other with such tenacity that I have not yet been able to obtain a complete separation of them.

The philippic formiate crystallises with great facility, either on cooling or by spontaneous evaporation, in small brilliant rhomboidal prisms less soluble than the formiate of yttria, which is deposited in mammillary form of a syrupy solution. The terbic formiate is anhydrous, and soluble in from 30 to 35 parts of water. The sodio-terbic sulphate dissolves with difficulty in a saturated solution of sodic sulphate, whilst the corresponding salt dissolves in it easily. I avail myself of this property to simplify

* *Archives des Sciences Phys. et Nat. de Geneve*, March, 1878, p. 273.

† YO 74·5, TbO=114.

‡ *Archives des Sciences Phys. et Nat.*, August 1, 1878, p. 89.

the extraction of these bodies. The philippic oxalate is more soluble in nitric acid than the terbic salt, but less so than the yttric salt. The philippic nitrate becomes a deep yellow colour when it is dissolved; those of yttria and terbia remain colourless. The salts of philippium are colourless; the earth becomes white in a current of hydrogen, and also on being calcined, but it becomes yellow again on exposure to the air during cooling. This colour does not appear to be due to any mixture with terbia.

In the spectroscope the concentrated solution of philippium gives in the indigo-blue (λ = about 450) a magnificent absorption-band, very intense, and rather broad, with well defined edges, especially on the right. This band, which strikes one at a first glance, is not seen in solutions of terbium, yttrium, and erbium. It is, then, characteristic of philippium, and thus M. Soret's conjecture, that it belongs to a new simple body, is confirmed. In the green I find two rather fine rays varying in intensity, the most refrangible of which belongs to erbium, as well as a faint ray in the blue near to the boundary of the green. The least refrangible of the green rays belongs perhaps to philippium, for if in some specimens it has been less intense, others, on the contrary, show it to be nearly as powerful as the erbium ray. Lastly, in the red there is at least one fine ray which I am not able to identify. By directing the slit of my spectroscope to the sun I observe through a blue glass with the terbium solutions a very pronounced band situated in the violet (λ=400 to 405). This, however, is difficult of observation. It is half the width of the philippium band, and seems to be entirely absent in certain specimens of the latter, whilst in others a trace of it is visible. I have reason to doubt whether this really characterises terbium, as M. Soret believes; it is possible that it may indicate yet another element, the atomic weight of which is intermediate between that of terbium and erbium.

I have for some time been pursuing the parallel study of the compounds of philippium and terbium, and in a few weeks I shall be able to publish a memoir in which I shall describe at length the methods of preparation and purification which I have employed.—*Comptes Rendus.*

THE METALLURGICAL USES OF TUNGSTEN.

MANY attempts have been made to improve the qualities of iron and steel by the addition of small proportions of other metals. The most promising of all the experiments made in this direction turn on the introduction of certain proportions of tunsgten or of chromium; and although these alloys can scarcely be said to have acquired as yet a firm footing in commerce, still results of indisputable value have been attained. In these important investigations particular merit belongs to the eminent metallurgist M. E. W. L. Biermann, of Hanover, who has devoted a great amount of time and expense to a thorough study of tungsten and chrome, and whose labours are beginning to bear important results. He finds that either tungsten or chrome may be advantageously incorporated with iron in the Bessemer process. He melts 3600 kilos. of grey pig-iron in a reverberatory furnace, and decarbonises it in the converter in the usual manner. He then mixes with it from 200 to 300 kilos. of a previously prepared alloy of tungsten, or of chromium, and iron. By this procedure he escapes all loss of tungsten or chromium by oxidation, and obtains a tungsten or chrome steel, in which either of these metals appears to be substituted for the carbon ordinarily present. This tungsten steel has been found to resist a greater breaking strain than the best "Huntsman's" steel. Puddled steel and iron and cast metal can also be decidedly improved in quality by additions of tungsten. These results are certainly not in accord with those obtained by earlier experimentators. But this is easily explained if we consider that many so-called tungsten steels contained not a particle of tungsten, whilst the metal in others was accompanied by arsenic, sulphur, phosphorus, and other impurities noxious to to the quality of iron and steel.

Tungsten further enters into the composition of other valuable alloys. Tungsten-bronze and an analogous compound of a rich violet colour are prepared by the reduction of melting tungstate of sodium (or potassium) with a further addition of free tungstic acid. Minargent, an alloy much used in America, and said to combine the colour and lustre of silver with the hardness of steel, is composed of 100 parts copper, 70 nickel, 5 tungsten, and 1 part aluminium. We feel no hesitation in calling the attention of metallurgists to an element which holds out such great promises, nor can we forget that its utilisation on the large scale would be a boon to the miners and mine-owners of Cornwall, where it exists in abundance.

We have received from M. Biermann specimens of his interesting preparations, and must congratulate him on their quality.

ON THE APPARATUS REQUISITE TO THE AMMONIACAL MANUFACTURE OF SODA, AND ITS USE.

By THORVALD SCHMIDT, Aalberg, Denmark.

ACCORDING to my promise I shall, in continuation of the article written by me (CHEM. NEWS, vol. xxxvii., p. 56), give a description of the method and apparatus used in the ammoniacal manufacture of soda, calculated to a daily produce of 1 ton of 98 per cent of soda, or 1½ tons of pure bicarbonate of soda.

There are wanted thirty-three different apparatus and eight pumps:—

1. *The Still (Apparatus for Distillation)*

is a cylinder, standing erect, pointed at the bottom, made of iron-plate, 4½ metres high, 2 metres diameter, provided with a leading pipe that can lead the steam to the bottom of the vessel. At the beginning of the operation the steam is to be taken from the steam-boiler, whilst only the waste steam from the pumps is used when the manufacturing is in full activity. In this vessel is just so much quick-lime as is necessary to transform the solution of chloride of ammonium, which arises from the continuous operation, into free ammonia and chloride of calcium. The still is filled with about three-fourths of its contents from the vessel 6, connected with the former by a leading pipe with a cock, and the distillation commences as soon as this is done and the cock for the afflux is closed. The cock from the steam reservoir 24 is opened, and the waste steam from the pumps is led into the bottom of the still, by which progress the fluid, already strongly heated, will be brought to boiling, and force the gases of the ammonia into the bottom of the tower 2. The distillation being ended, the cock for the escape of the ammonia and the blow-off cock are opened. By this operation the solution of the chloride of calcium is pressed out, until the still is emptied; again quick-lime is added, the cock from the reservoir 6 is opened, the requisite quantity of solution is filled into the still, and the distillation begins again.

2. *The Tower for Distillation*

is a cylinder standing upright, also made of iron-plate, 5 to 6 metres high, 1·3 metres diameter, and at a distance of 0·4 metre from the bottom it is provided with a strong iron grate, beyond which the steam from the still is led almost to the bottom of the tower, by which means the fluid contained in the boiler, and the height of which is regulated by the outlet-pipe, is brought to boiling; the hot

team will go through the grate, and the limestone, lying on the latter through the whole height of the tower, while, on the other side, the solution that comes from the reservoir 19—consisting of dissolved bicarbonate of ammonia, bicarbonate of soda, and chloride of ammonium—is pumped into the upper part of the tower, from whence it pours down over the limestone. The boiling-hot steam that meets the solution will force the latter to let free the carbonic acid and the ammonia, while the solution of chloride of ammonium and the hot solution of the chloride of sodium will run into the reservoir 6, which is again connected with the still. The gaseous ammonia combined with the escaping carbonic acid are led through the cooling apparatus, 28, 29, and 30, and further into one of the—

Cylinders, 3 and 4,

which are 3 metres high, 1½ metres in diameter, and also made of iron-plates. The pipes that lead the ammonia gas coming from the still and the tower 2 through the refrigerators 28, 29, and 30, into the solution of salt in the vessels 3 and 4, almost down to the bottom of the vessels, are in their ends provided with a funnel full of holes, that the gas may be absorbed by the fluid. A system of cooling pipes, with a surface of an extension as large as possible, prevent the fluid from getting hot. When the solution in 3 is saturated with 9 per cent of ammonia and 17 or 18 per cent of chloride of ammonium, it is shifted into 4, which is performed by closing a cock on 3 and opening the corresponding cock on 4. When the solution is quite prepared a cock is opened, and a leading pipe conducts the fluid into—

The Reservoir 5,

which is a horizontal cylinder, large enough to hold as much of the fluid as the cylinders 3 and 4 together. This reservoir is in connection with the pump *e*, that takes the solution to the upper part of the tower 8.

The Reservoir 6

is also a horizontal cylinder, receiving the fluid that comes from the tower 2, from which it is afterwards led into the still.

7^1 and 7^2. *The Absorbers*

are two cylinders, made of iron sheets, standing upright on their one end, 7 metres high and 1 metre diameter, provided with a double bottom, the upper end of which is furnished with 2 m.m. holes. The carbonic acid from the pump, *a*, is pressed into the space between the two bottoms, and escapes through the holes in the uppermost bottom. The area of the said holes together is calculated thus—that there arises a pressure large enough to bear the fluid poured into the absorbers. The carbonic acid will rush through the holes during the working of the pumps, and will in this manner get into near contact with the column of fluid poured in from the reservoir 14, and standing 6½ metres high. There will come forth bicarbonate of ammonia, which again, in connection with chloride of sodium, will be converted into bicarbonate of soda and chloride of ammonium. During this process the apparatus is kept rather cool by means of the water circulating through the cooling-pipes, partly because the precipitating process then proceeds more beautifully and the result is more coarse-grained, and partly because there will be precipitated more of the bicarbonate of soda when the fluid is cooled than if this is not the case. The precipitated bicarbonate of soda will keep floating in the solution, which is caused by the carbonic acid striving upwards, and care must be taken that the precipitating process may go on as fast as possible, for which purpose 20 to 24 per cent of carbonic acid is necessary. Great motion through the fluid will break up the crystals if the precipitation should last too long, and we should have a clayey and greasy mass that would give bad bicarbonate of soda, difficult to calcine, and giving bad soda. Coarse-grained bicarbonate of soda will give the finest and purest produce. As soon as the precipitation is finished the cock for the outlet-pipe, that leads the escaping gases into the tower 8, is closed; the cock that leads into the filter 18 is opened; and all the fluid, together with the bicarbonate of soda in it, is to be pressed out as fast as possible, that the absorbers may be filled again immediately with fresh lye and a new precipitation may begin.

The Tower 8.

All the gases that have passed the absorbers are to be led from them by means of a leading pipe into the bottom of the tower 8. This tower is 6 metres high and 1½ metres in diameter, but for the rest mark wholly as the tower 2; there is only the difference that above the grate is filled with round flint-stones instead of lime-stones. By means of the pump, *e*, the lye gathered in the reservoir 5 is pumped through a filter-press, 26, into the tower 8. When the lye thus filtered, in a pure and clear state, pours down among the stones, it will meet the carbonic acid not used, but escaped from the absorbers, 7^1 and 7^2, by which progress the lye will be thus saturated, and we shall have chloride of sodium and carbonate of ammonia in the solution. This fluid will stream from the tower into the reservoir 14, and by the aid of the pump *g* it is to be pumped into the absorbers when the latter is to be filled.

The Tower 9.

Those gases escaping from the tower 8 have now given their carbonic acid to the salt-lye, saturated with ammonia, but they still contain some ammonia. In order to keep back the latter the gases are led into the bottom of the tower 9. This tower is quite like the tower 2, both in height and diameter, but, like the tower 8, is filled with flint-stones. From the reservoir 20 the salt-lye is led through a leading pipe into the upper part of the tower; it will trickle down among the stones, and absorb the upward-going ammonia gas. The fluid runs down into the reservoir 15, and is, by means of the pump *f*,—if it is necessary,—driven into one of the cylinders, 3 or 4, each time one of them is emptied.

The Tower 10

is made of wood lined with sheets of lead, 1 metre high, ½ m. in diameter, arranged quite like the aforesaid towers, 2, 8, and 9, but filled with coke. The gases escaping from the tower 9 are led into the bottom of this tower, and will here, when they ascend, meet a diluted sulphuric acid trickling down through the coke, to absorb the small quantity of ammonia that may still be left in the escaping gases, before they are led into the air. By means of this tower the whole working of the manufactory is to be controlled in a similar manner as is done in a manufactory of sulphuric acid, by examining the escaping gases.

The Reservoir 11

is an open box, made of wood lined with sheets of lead: in this is gathered the dilute sulphuric acid that has passed the tower 10 and absorbed the last traces of ammonia. By-and-bye, as the acid is saturated with ammonia, there is put more sulphuric acid, till it becomes so concentrated that no precipitation of sulphate of ammonia is to be feared; it is then led to the still by the aid of a leading-pipe provided with a cock. The reservoir 11 is, by means of a leading-pipe, connected with—

Montajus, 12,

made of iron, lined with sheets of lead, and is in connection with the—

Air-Pump, 13,

that presses the fluid gathered from the tower 10 in the reservoir 11 into the reservoir 27, from which it again trickles through the coke into tower 10.

The Reservoir 14

is a horizontal cylinder large enough to receive all the lye

running from the tower 8, with which it is connected by a pipe, and through a pump, *g*, is put in connection with the absorbers.

The Reservoir 15

is also a horizontal cylinder, and serves as a reservoir for the tower 9, for the salt-lye that is saturated with ammonia; and from here the lye is pumped through a pump, *f*, to the cylinders 3 and 4; by-and-bye, as one of them is emptied, it may be filled again.

The Lime-Kiln, 16,

is a round oven, whose inward measure is 4 metres high, at the bottom 1½ metres, and at the upper end 0·8 metre in diameter. It is constructed thus that the burning of the lime may go on without interruption, the lime-stones being poured in, mixed with coke, through a hole furnished with a closely shutting cover, while the burnt lime is taken out from underneath on one side of the oven. The current of air is produced by the carbonic-acid pump, *a*, sucking the air through the limestone and the coke in the oven, by which process the red-hot lime-stones give off their carbonic acid, which is sucked through a leading-pipe into a closed vault, where the ashes that are carried with the current of air get time to deposit. On this vault is placed—

The Calcining Oven, 17.

It is built of sheets of iron 10 m.m. thick, and is placed thus on the brickwork as to form the foundation for the oven, which is 3 storeys high, and fitted thus that the washed-out bicarbonate of soda that is to be calcinated is poured into the upper stove, from which it glides to the centre one, and from there into the last stove, where the calcining is completed. The oven is constructed thus that the almost ready soda meets the hottest carbonic acid, whilst the filled-up bicarbonate meets the already somewhat cooled carbonic acid. We may fill up bicarbonate from above, and draw out calcined soda from beneath. The quantity of carbonic acid we want to apply during the calcining process is to be regulated after our own wishes; we may let it pass between the interstices of the oven, or lead it around the latter; we gather it in a leading-pipe that leads to the washing-apparatus, 21, whilst the carbonic acid evolved by the calcining of the bicarbonate is led through a cooling apparatus, 32, direct to the absorbers.

The Filter, 18,

receives all the bicarbonate prepared in the absorbers, together with the produced lye of chloride of ammonium. It is a round reservoir, made of sheets of iron, at the bottom of which are fixed two strata of pieces of wood crossing each other; on the uppermost stratum is stretched a piece of light linen cloth, and the circular frame on which it is stretched fits accurately to the sides of the filter. The filter is, moreover, covered with a similar piece of linen cloth, which also is stretched over a circular frame. When the absorbers are to be emptied the uppermost frame is made fast, the cocks from the absorbers opened, and the pressure in the latter will force the fluid to rush out, taking with it all the bicarbonate. When the absorbers are emptied the cock is closed, and from the reservoir 14 is pumped new fluid in with the pump *g*, that it may be filled anew. The pump *h*, connected with the filter through a leading-pipe, sucks all the solution of chloride of ammonium from the bicarbonate which is left on the cloth, and the solution is pressed into—

The Reservoir 19,

which, like the rest of the reservoirs, are cylinders made of iron-plate. From this the fluid is taken out by the pump *d*, which, as we learned by the description of the tower 2, leads the fluid into the upper part of the latter.

The Vessel for the Solution of the Salt, 20,

made of wood, with a double bottom, the uppermost of which rests on strong beams, to carry the weight of the salt. This vessel is always kept full of salt and water, and must be placed at so great a height that the tower 9 has the uppermost bottom about ½ metre lower than the uppermost plane of vessel 20. Along the side of this an iron leading-pipe goes up the vessel, and afterwards to the tower 9, from where the salt-lye trickles down over the flint-stones, to absorb the ammonia gas that escapes from the tower

The Tower 21

is made of wood or iron sheets. The hot carbonic acid coming from the lime-kiln is, through a leading-pipe, led to the bottom of this tower. The whole tower is filled with coke, over which cold water trickles. When the carbonic acid has passed the water it is washed and cooled; then it is sucked by the pump *a* into the upper part of the tower, and from there to the absorbers, 7^1 and 7^2.

The Sieve, 22,

is only used in places where the lime is not good.

The Well, 23,

is a reservoir for the water.

The Collector of the Waste Steam, 24,

is furnished with a valve, so that the latter opens if the pressure should become too strong. All the waste steam from the pumps is gathered here, and gives the necessary heat to the still: if no distillation takes place the steam goes into the air.

The Vessel 25,

for the washing-water for the filter, is a small box with a leading-pipe.

26. *The Filter-Press.*

Through this press all the lye from the reservoir 5 is pressed into the tower 8. On this cleaning of the lye depends the quality of the produce.

The Reservoir 27,

from which diluted acid runs into the tower 10.

28, 29, and 30. *Cooling Trays*,

in which there are eighteen leading-pipes. The cooling process is arranged so that the hottest gas meets the hottest water and the most cooled gases the coldest water. The gas is ammonia-gas, coming from the tower 2, and is led to the cylinders 3 and 4.

31. *The Funnel for the Lime-water*

is only used where the sieve must be used.

32. *Cooling Tray*,

for the carbonic acid escaping from the calcining process is connected with the pump *b*.

33. *The Reservoir for Water*

for the leadings to all the cooling-pipes.

The Pumps.

a. For carbonic acid from the lime-kiln.
b. For carbonic acid from the calcination.
c. For water.
d. For the lye from the reservoir 19 to the tower 2.
e. For the lye from the reservoir 5 to the tower 8.
f. For the salt-lye from the vessel 15 to the cylinders 3 and 4.
g. For the lye from the vessel 14 to the absorbers, 7^1 and 7^2.
h. For the fluid from the filter 18 to vessel 19, and at the same time for the washing-out water from the filter 18 to vessel 25.

For drawings, showing the details of a single apparatus, I have fixed the price at £10; of all the apparatus, £50; and for complete drawings, description of the whole

way of manufacturing, &c., £100. It must be mentioned for how large a produce the drawings are wanted.

The raw materials for 100 parts of 95 to 97 per cent soda are, using the latest improvements, 160 to 170 parts of rock-salt, or a corresponding quantity of salt-lye, 170 to 180 parts of coal, 120 parts of limestone, 2 to 3 parts of sulphate of ammonia, 1 part of sulphuric acid, and 30 parts of coke.

ON THE PYROLOGICAL EXAMINATION OF ZEOLITIC SILICATES.

By Lieut.-Colonel W. A. ROSS.

THE term *Zeolite* is itself used to denote a silicate, but the adjective form is preferred because—

(1.) Many minerals other than these silicates fuse and "boil" before the blowpipe.

(2.) Difference of opinion as to what are and are not *Zeolites* seems to prevail among mineralogists. Nicol ("Mineralogy," 1873) enumerates only twenty-two species of this "family," in which he includes *Apophyllite*; Des Cloizeaux (1862), and Dana (1850), describe about sixty individuals, and do not include *Apophyllite*; Brooke and Miller (1852) ignore the term altogether, including it in the more general one, "Hydrous silicates."

Apart from these technical distinctions, this peculiar kind of silicate appears to be at once interesting and difficult to chemically decompose so as to enable the field geologist or mineralogist to arrive rapidly at a sufficient knowledge of its constituent parts. I propose, therefore, to ask the attention of these and other scientific travellers to the merits of *Boric Acid* before the blowpipe as the quickest means known of obtaining a correct, if general, knowledge of the composition of the non-metalliferous rocks, more especially of those containing the alkaline earths, as lime, &c.

These, it will be remembered by readers of my published work on blowpipe analysis, called "Pyrology," have the curious property of forming balls when fused upon a bead of boric acid before the blowpipe, which float in a very peculiar and striking manner within the bead, as internal sphericles composed apparently of definite borates of these bases, while silica and alumina remain apparently unchanged by this operation, the former as transparent, the latter as fat-like fragments. The cause of this curious phenomenon seems to be shown by the behaviour of lime carbonate in a bead of boric acid. A pin's head fragment heated by the blowpipe refuses to combine with the boric acid until its carbon dioxide has been completely eliminated, when, glowing brightly, it suddenly takes up exactly 4·5 times its weight of boric acid to form a calcium borate ball, which is almost as hard, transparent, and refractive as a first class diamond. This combination, being of a different density from the containing bead of boric acid, and yet like it fluid before the blowpipe, assumes a spherical form within the bead for "capillary" reasons; just as a drop of oil does, in water or milk.

Now, in some zeolitic silicates, the small proportion of lime present is counterbalanced by alumina and often an alkali, so that this ball formation in boric acid is spoiled, doubtless by this combination preventing the lime from becoming caustic, as the mineral generally *fuses* before the blowpipe, after which its powder applied B.B. to boric acid, merely floats like a piece of ice or jelly in the bead, and rapidly dissolves in it on further heating. That alumina is the chief cause of this phenomenon is shown by the behaviour of the lime silicate, *Apophyllite*, which, although containing considerable quantity of alkali but no alumina, at once forms balls in boric acid before the blowpipe, while *Zoisite*, which contains a large proportion of lime with alumina, but no alkali, will not form balls. In this difficulty, my friend, Mr. Hutchings of Freiberg, who has for some time devoted his leisure to the examination of boric acid reactions, suggested to me the previous use of ammonium fluoride gently heated in a platinum capsule with 1-10th bulk of mineral, in order to get rid of the silica; stating that it had been suggested to him by Capt. Dowler.

It being impossible to procure the pure salt commercially in London, I communicated my difficulties to Dr. Guthrie, F.R.S., who, with a kindness and courtesy I can never forget, *made* a considerable quantity of the treasured reagent for me in sealed tubes, and a little bottle of paraffin from which to use it, as, in his words, "it is an extremely dipsomaniac salt."

After some fifty experiments with the ammonium fluoride process I was compelled reluctantly to give it up, because I found that, although it succeeded with definite mixtures of silica, alumina, and lime, and even with so perfect an artificial lime silicate as Bohemian glass, it failed completely with such zeolitic minerals as *Labradorite*, *Zoisite*, *Prehnite*, *&c.*, which, after the fluoride treatment, gave precisely the same results in boric acid that they did without any treatment at all; viz., an icy mass in the case of *Labradorite*, *&c.*, and a milky matter in the case of *Zoisite*, *&c.*

Mr. Hutchings, however, informs me that after many laborious quantitative experiments extending over some months, with lime, alumina, silica, and alkali, he has obtained such results by means of the fluoride process and boric acid as enable him to state confidently the constituents, and approximately the quantitative composition of any of these minerals in a few minutes.

For my part, after failing with ammonium fluoride, I thought there *must* be some preparatory process by which such a mineral as *Zoisite*, containing so much as 24 per cent of lime, could be made to exhibit balls in boric acid before the blowpipe, and, as I had long ago found that calcium *phosphate* forms opaque white balls in boric acid, much more difficultly dissolved by an added alkali than the clear balls formed by pure lime, it struck me to try *Zoisite* powder directly, in a mixture of boric and phosphoric acids, and to my great satisfaction, after the bead had remained red-hot before the blowpipe for same time, shining *white*-hot particles made their appearance, which through a lens were found to be white opaque balls, floating in the partly clear bead, and seemingly a double phospho-borate of lime and alumina, while the silica was diffused as a water-gruelly looking matter throughout the bead. The balls can easily be obtained separate by boiling the bead in water, and throwing the contents on a blotting pad.

Labradorite, which only contains about 10 per cent of lime, with half as much alkali, and a large proportion of alumina, was analysed in the same manner, only the resulting balls, in this case, were *clear* and transparent, like those formed by pure lime.

Thus, the geologist and mineralogist, with a blowpipe, pyrological candle, platinum wire, a lens, and a little boric and phosphoric acids in his pockets, may, after a little experience, analyse in a few minutes, in a shed, or any sheltered place near the scene of his operations, these complicated minerals, almost as minutely and correctly as the chemist in his laboratory.

The student may infer how unsatisfactory, and indeed, utterly worthless, is the present system of blowpipe examination of all such minerals, by referring to Plattner's "Examples," page 498. "Probirkunst mit dem Löthrohre,' (omitted in the pirated English translation), article "Kieselsaure Kali-Thonerde (Feldspath, Adular)," while all that M. Des Cloizeaux—still incomparably the best writer on the silicates—can say on the subject with regard to *Labradorite*, is—"Au chalumeau, fond un peu plus facilement que *l'Orthose*, en un verre blanc, semi-transparent, et colore légèrement la flamme en jaune."

As no zeolitic silicate contains sufficient alkali to decompose lime-balls in a bead of boric acid, it is obvious that such decomposition is a most delicate test for the presence of *alumina*; and it may be made quantitative by previously weighing the ball; all subsequent diminution

in weight being proportional to the amount of alumina present.

London, Oct. 24, 1878.

NOTES FROM THE PARIS EXHIBITION.

Chemical Products.
No. II.

Messrs. J. E. Williams and Co., who are colour and oil merchants, exhibit, besides a number of paints, &c., a new preparation called terebine, for mixing with oils, paints, and varnishes, for the purpose of making them dry more easily, especially when they are used for outside purposes or in damp weather. It will be very useful to house and ship painters, particularly the latter, as ships are nearly always damp. It is recommended to be used in the proportion of from 1 to 2 ozs. to every pound of paint, and about 10 ozs. to every gallon of oil or varnish.

Messrs. Southall Brothers and Barclay exhibit their "soluble meat," which they claim to contain all the constituents of the best lean beef; such as all the fibrin and albumen, as well as the extractive and saline matters. It differs from most extracts of meat in this respect, that the latter do not contain the flesh-forming materials, but only the saline and extractive matters. This firm has received the award of a Bronze Medal.

John Richardson and Co., manufacturing pharmaceutical chemists, show various quantities of their pills, which are enveloped in a substance which preserves the contents, and is easily soluble in the gastric juice of the stomach. They are said to have advantages over other pills of their kind, as the contents are not injured at all in the making. Messrs. Richardson and Co. also exhibit some phosphorised and simple cod-liver oil in a very pure state; the phosphorised oil is especially recommended for children. Their pocket medicine chests are arranged in a very compact form; they contain a few of the most urgent remedies for cases of need. A Bronze Medal has also been awarded to this firm.

The British and Foreign Mineral Water Company exhibit all kinds of artificial mineral and aërated waters, for which they have received the distinction of Honourable Mention. Analyses of many of them are given, showing that some of them contain 16, 18, and 20 ingredients, some in very minute proportions.

Messrs. Solvay and Co. exhibit some ammonia soda products, carbonate of soda, &c., which is made by their process. Solvay's process is about the only one which has yet been worked successfully on a large scale; many attempts have been made by various manufacturers to carry out practically this method of preparing carbonate of soda, but they have all failed, and their failure is attributed to the very delicate nature of the manufacture, or the imperfect apparatus devised for the operation. Some French inventors, however, were of opinion that their want of success was owing to the stringent laws regulating the use of salt in chemical works, but in this they were mistaken, as has since been proved. It may be known that the reaction which is the basis of the process takes place when chloride of sodium and bicarbonate of ammonia are brought together, the double decomposition which takes place forming bicarbonate of soda and hydrochlorate of ammonia; the bicarbonate of soda is afterwards decomposed by heat to form carbonate of soda, and the hydrochlorate of ammonia is distilled with a carbonate and the necessary bicarbonate of ammonia made. It would seem that this reaction, which is so easy to perform in the laboratory, should with care be successful on the large scale, but it is by no means an easy operation. The first idea of this reaction being applied to manufacturing purposes was in 1838, when a process was patented by Dyar and Hemming. Since then many patents have been taken out for the same purpose both in England and France, and several of them claim the discovery of the principle; even Mr. Solvay's original patent granted in 1861 relates to the principle. Works have been started in various parts of England and the Continent at different times, but none of them succeeded. It was in 1863 that Mr. Solvay's first apparatus was patented; he had before that time carried on a series of experiments near Brussels, and as they turned out to be successful he determined to have permanent works erected, which was done at Couillet. Solvay's process is now worked in four different establishments; at Couillet, in Belgium, where 7500 tons of pure carbonate of soda are produced annually; at Varangéville-Dombasle, in France, where the annual production is 20,000 tons; and at Northwich and Sandbach, in England, where the total production amounts to 13,000 tons a year; thus 40,500 tons of carbonate of soda at 91½° Descroizilles are annually produced by Solvay's process. The works in France are the most important, and as they are built on a natural salt-bed, there is no expense in bringing that part of the raw material to the scene of the operation.

Dreyfus Brothers and Co. exhibit a quantity of Peruvian guano, of which they are the importers. As is well known this guano is a deposit left by seabirds on the islands and rocks in the Pacific Ocean, and not rarely the bodies and heads of birds are found buried in the deposit, which in some places is as much as 30 yards deep. It has been found by analysis and practical experiments that the Peruvian guano is very rich in nitrogen, lime, potash, and soluble phosphates, all of which play an important part in the nourishment of plants. The guano should be applied in damp, but not too rainy, weather, and not later than the month of April; it is also recommended to mix the guano with two or three times its own weight of cinders, charcoal, salt, or dry earth, &c., but never with lime, and in nearly all cases the mixture should only be made a day or two before it is required; mixing the guano with salt is specially reccommended when it is only laid on the ground and not dug in. The reason of this is that the salt stops the carbonate of ammonia contained in the manure from volatilising when the weather is dry or windy. The Peruvian guano does for all kinds of crops, such as wheat, barley, oats, potatoes, carrots, colza, and even tobacco.

Mr. Peter Spence has a splendid exhibit of alum in the form of large cubical blocks, which are built up to about the height of twelve feet, forming a large square tower; at the four top corners of the tower are some very large crystals of the same substance. This alum is called the Turkey-red alum, as it is specially made for the Turkey-red dyers; it is in a very pure state, containing only one part of oxide of iron for every 500,000 parts of alum. Mr. Spence's only other exhibit is his patent aluminoferric cake. It is manufactured from the mineral bauxite, which contains aluminous and ferric oxides, together with a small quantity of silica. It is used for clarifying sewage waters, for which process it has been found very effective at the Native Guano Co.'s works at Aylesbury. Mr. Spence has been awarded the gold medal for his alum exhibit.

Messrs. Coquerel and Co., who are large manure makers, exhibit some of their chemical manures, as well as the raw materials with which the same are made. In their case may also be seen some paintings of the different parts of their works, which are very conveniently situated on the banks of the Seine, near Paris. This company was founded in 1874, but too late in the year to profit by the autumn sales, so the manufacture of the manures was not commenced until the following year, when only 800 tons of manure were sold; but as these manures gave most satisfactory results, the demand for them increased; so the works were enlarged, and in 1877 the sale had increased to 6000 tons for the year. The machines for making and mixing the manures are placed in a large three-storeyed building, while in other buildings and sheds are stored large quantities of raw material and

manure. The machines consist principally of—(1) a crushing or powdering machine, which will pulverise 80 tons of matter a day; (2) the mixing apparatus, capable of making 10 tons of manure an hour; (3) the sulphuric acid bath; and (4) the drying-pits, which are directly underneath the other apparatus. The machines for making the superphosphate and the phospho-guano (which are similar in composition) are composed of a cast-iron cylinder, in which revolves a spindle which has several arms projecting at right angles to it, a sulphuric acid bath, and a drying-pit. The phosphates are put into the cylinder at regular intervals and in measured quantities, while at the same time the sulphuric acid runs in from above, where it has been heated in a leaden bath with leather, feathers, or other organic bodies, which it partially dissolves. When the mixture is thoroughly made in the cylinder, a trap in the bottom is opened, and the contents fall down into the drying-pit beneath, where they stop for some hours, until formed into a hard mass, which is dug out and powdered, mixed with other ingredients, and put into casks ready for carriage to its destination. The apparatus just described is partially enclosed, and is put in connection with a powerfu ventilator, which draws off and disinfects all noxious vapours. The works are directed by a chemist who makes all the formulæ for the manures, the quantities of the ingredients being fixed according to the results of the analysis of the raw materials: thus everything that goes in or out of the works is analysed in the laboratory attached to the building so as to be sure of its proper constitution. The manures made by Messrs. Coquerel and Co. are not all purely chemical manures; the great difference between them and those of most makers being in the form in which the nitrogen is applied. In purely chemical manures nitrate of soda is generally used, and with it excellent crops are obtained; but M. Coquerel has shown by practical experiments that the ground is not in such good condition after the crop, when the nitrogen has been applied as nitrate of soda, as it is after the nitrogen has been applied in the form he recommends, viz., obtained from some organic body (preferably leather) by treatment with sulphuric acid. In this way M. Coquerel is enabled to make as good a manure at a lower price than those makers who use nitrate of soda; and, further, he leaves the ground in a better condition for the next crop. The manures made at these works are eight in number: they are suitable for all kinds of agriculture and climates. A great quantity is exported annually to the West Indies for the sugar-canes, and agents are employed all over France. Below is given a table showing the percentage of the principal constituents in the manures:—

Name of Manure.	Nitrogen.	Phosphoric Acid.	Phosphate of Lime.	Salts of Potash.	Lime.
1. Phospho-guano	3 to 4 p.c.	12 to 13 p.c.	25 to 28 p.c.	—	25 to 30 p.c.
2. Do. rich in nitrogen ..	5 6	8 9	17 19	—	15 20
3. Chemical	5½ 6	7½ 8	17 18	—	15 20
4. For beet-root	7 8	4 5	8¾ 10	10 to 12 p.c.	10 15
5. For potatoes..	4 5	4 5	19 20	25 30	15 20
6. For maize and flax ..	3½ 4	9 9½	10 12	15 16	20 25
7. For grass fields	3 4	5 6	15 17	6 8	20 25
8. For vegetables	½ 1	7 7½	8¾ 10	15 16	25 30

Messrs. J. Laureau and Co., who are also makers of artificial manures, exhibit several kinds, the most important of which are the Fish Manure, Phospho-guano, and the Breton manure. The fish manure is made from the residue left after the manufacture of fish oils: the cakes thus obtained are said to be very rich in phosphoric acid. The Breton manure is prepared from different animal and vegetable matters, together with a small portion of sea-salt. It is specially prepared for vines, its composition being such that the vines can easily draw their nourishment from it. It also serves to protect the vines in a certain degree from some of the maladies which are continually ravaging vineyards.

The North British Chemical Co. (Limited) have a very interesting exhibit of chemical products made from seaweeds. They consist chiefly of compounds of potash soda, iodine, bromine, and charcoal. The process now used is essentially different from the old one. The seaweed, instead of being burnt in open vessels—as was formerly the practice, when a great deal of iodine used to be lost owing to the high temperature—is subjected to destructive distillation in closed retorts, whereby about 50 per cent more iodine is obtained. After the distillation is finished, the constituents of the seaweed are found distributed as follows:—In the retort is a mass of charcoal containing several other matters; in the condenser a quantity of ammoniacal liquor; and in a suitable reservoir, fitted for its collection, is a gas which is used for lighting the whole of the works. The charcoal left in the retort is then subjected to lixiviation, and from the solution is obtained potash, soda, iodine, and bromine, which then undergo the several operations necessary for getting them into the desired form. The charcoal left after the lixiviation is found to be very much like that obtained from bones, and it has the property of being a very powerful deodoriser and disinfectant. The liquor which is obtained in the condenser after the distillation is decomposed, and ammonia and acetic acid are obtained from it. Most of the seaweed employed in this industry is collected on the coasts of the Hebrides during the winter months, thus giving employment to numbers of poor people who would otherwise be without means of subsistence, owing to the inclement state of the weather. There are two kinds of seaweed employed by this company, each having its special use. The first is drift-weed, which is washed ashore after storms or high winds; the second kind is called cut or tangle weed. It is cut or gathered from the rocks in calmer weather, hence its name. The former is particularly rich in iodine, and is therefore reserved for the production of that element. The latter is the material from which the other products of distillation are principally obtained, the percentage of iodine being much smaller. The first crude salts obtained from the charcoal are generally potassic chlorides, from which are obtained potassic chlorate and sulphate: from the potassic sulphate is obtained carbonate of potassium, from which iodide and bromide of potassium are formed. The iodine is sometimes re-sublimed, and is obtained in a very pure state. Various other products are made, and are exhibited in the case, together with samples of each of the salts and other materials above mentioned. The seaweeds are shown side by side with the several charcoals before and after lixiviation. Samples of sewage water are also exhibited, before and after being treated with the charcoal; the difference shows that the charcoa employed is a good purifier. The Company also exhibit a new disinfectant, which bears the name of chloricalcium.

Messrs. Bowdler and Bickerdike, who, as it appears from the character of their exhibit, are large manufacturers of carbolic acid, show many different samples of that well-known disinfectant, and other phenic compounds. They have a large quantity of absolute phenol and picric acid, coralline, and creosol, and some very good crystals of pure carbolic acid.

M. Bobœuf, in the French Chemical Section, is also an exhibitor of carbolic acid. That prepared by him is the only carbolic acid that has been considered worthy of the Montyon Prize, awarded by the Institute of France. He

also exhibits some perfumed carbolic acid which is meant to be used for the toilet, as it does not leave behind it the peculiar odour that so many people object to in carbolic acid.

H. C.

THE AWARDS AT THE PARIS EXHIBITION.

We have now received the official list of the awards made to British exhibitors at the Paris Exhibition. From it we extract the following list of prizes for chemicals, chemical apparatus, &c. :—

Grand Prizes.

Johnson and Matthey, for Refining Machinery; and also for Platina.

Gold Medals.

Chemical Products.—Brooke, Simpson, and Spiller, London, for Colouring-matters. E. Cook, London, Pure Soap. Hodgson and Simpson, Wakefield, Soaps. Charles Lowe and Co., Manchester, Products from Coal-Tar; Carbolic Acid and its Derivatives. T. and H. Smith and Co., Edinburgh, Alkaloids. Price's Patent Candle Co., Battersea, Paraffin, &c. Peter Spence, Manchester, Alum and Alumino-ferric Cake. Charles Tennent and Co., Glasgow, Chemical Products. Williams, Thomas, and Dower, Brentford, Artificial Colouring Matters. Wilkinson, Heywood, and Clarke, London, Varnishes and Colours. Young's Paraffin, Light, and Mineral Oil Co., Oils, Essences, Paraffin, Candles.

Apparatus.—Hargreaves and Robinson, Widnes, Apparatus for Manufacture of Sulphate of Soda.

Silver Medals.

Chemical Products.—Burgoyne, Burbidge, Cyriax, and Farries, London, Pure Chemicals and Pharmaceutical Products. W. J. Bush and Co., London, Essential Oils. Griffiths, Fletcher, and Berdoe, Liverpool, Colours. R. S. Hudson, West Bromwich, Extract of Soap. Hurlet and Campsie Alum Co., Glasgow, Prussiate of Potash. L. J. Levenstein and Sons, London, Artificial Colouring Matters. J. Mactear, Glasgow, Chemical Apparatus, Products, and Preparations. J. F. Macfarlan and Co., Preparations from Opium, Beberin, and Salacin. T. Morson and Son, London, Chemical and Pharmaceutical Products. Mander, Brothers, London, Varnishes. North British Chemical Co., Glasgow, Iodine, Bromine and Derivatives. Runcorn Soap and Alkali Co., Liverpool, Bleaching-powder, Soda-ash, Soda Crystals, Caustic Soda, Sulphate of Soda, Refined Rosin. Savory and Moore, London, Chemical Products and Preparations. Simpsons, Payne, and Co., London, Paraffin, &c. C. Turner and Son, London, Varnishes, Colours, Gums, Turpentine.

Apparatus, &c.—F. S. Barff, London, Non-corrosive Iron. J. Cliff and Sons, Leeds, Crucibles and Retorts. J. Mactear, Glasgow, Soda Furnaces. Patent Plumbago Crucible Co., Crucibles.

Bronze Medals.

Chemical Products.—Berger, Lewis, and Sons, London, Colours. Boyd, Son, and Co., Dublin, Chemicals. J. and J. Colman, London, Washing-blue. J. Chambers and Co., London, Chemical Products. Desoto Alkali Co., Widnes, Caustic Soda, Soda Crystals. Foster and Gregory, Streatham, Chemical Products. A. B. Fleming and Co., Edinburgh, Inks. H. Glover, Son, and Co., Bradford, Dry Soap. Golding, Davis, and Co., Widnes, Chemical Products. Gidney, Clark, and Co., Stratford, Varnishes. S. Hemingway and Co., Bradford, Dry Soap. T. Jennings, Cork, Magnesia. Liver Alkali Works Co., Liverpool, Caustic Soda. W. Lyons, Manchester, Inks. J. B. Readman, Glasgow, Chemical Products, Phosphorus. J. Richardson, Leicester, Chemical and Pharmaceutical Products. Rolls, Schweizer, and Co., London, Varnishes. H. Shaw and Co., Manchester, Dry Soap. Silicate Paint Co., Liverpool, Colours. H. C. Stephens, London, Inks. Tyne Alkali Co., Newcastle-on-Tyne, Chemical Products. Washington Chemical Co., Newcastle-on-Tyne, Carbonate of Magnesia. Wilson and Co., London, Colours.

Honourable Mention.

Everett and Co., London, Blacking and Varnish. E. James and Son, Plymouth, Washing-blue, Blacklead. Jarratt Brothers, Bradford, Dry Soap. Jenson and Nicholson, London, Varnishes. Langthorne Chemical Works, London, Chemical Products, Leech and Neal, Derby, Colours. J. Mackay and Co., Edinburgh, Varnishes. Oakbank Oil Co., Glasgow, Shale and its Products. Reade, Brothers, Wolverhampton, Varnishes and Japan. Robinson and Anderson, Bermondsey, White Lead. Sir W. A. Rose and Co., London, Oils, Greases. St. Bede Chemical Co., Newcastle, Manufacture of Soda. Yorkshire Varnish Co., London, Varnishes. Burnard, Lack, and Alger, Plymouth.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 15, October 7, 1878.

Singular Case of Heating in a Bar of Iron.—M. Hirn.—The writer describes a case where a bar of iron, struck with a sledge-hammer at one of its extremities, underwent at every blow a rise of temperature to the extent of about 30°, returning immediately to its former heat. He considers that, in certain particular conditions, sonorous vibrations, shaking the nerves of sensation, may determine at the periphery of the human body a sensation of heat, just as a pressure upon the eyes produces in them a sensation of light.

Observations on the Subject of the Note by M Bouillaud inserted in the "Comptes Rendus" of the Session of September 30th.—M. Th. du Moncel.—The author, having produced an experimental refutation of the views of M. Bouillaud, remarks—"I cannot help feeling astonished that M. Bouillaud has been so late in expressing his doubts now the phonograph, the telephone, and the microphone are in the hands of everyone. I shall not insist upon the theory of the effects produced in these experiments. I have even shown that the experiment of the singing condensor, along with many others, proves that the effects of electro-magnetism are not necessary for the reproduction of speech. These results are doubtless difficult to explain in the present state of acoustics, yet if I consider the sum total of the experiments which have been transmitted to me from all sides, and of those which I have performed myself, it seems that sonorous vibrations may result from every reaction of two bodies having the effect of producing abruptly and at near intervals modifications in the state of their magnetic or electric equilibrium."

[The discussion on the telephone and the phonograph raised in the Academy of Sciences by M. Bouillaud has created a feeling of painful surprise. At the meeting on Sept. 30 M. Bouillaud, by implication at least, pronounced M. Th. du Moncel a "skilful ventriloquist." This is justly considered dishonouring to the Academy, and M. Fizeau, the president, is declared to have "forgotten the duties imposed upon him by his official position. A writer in *La Correspondance Scientifique* says that in the interest

of the reputation, even of M. Bouillaud himself, who has been an eminent physician, he should have been prevented from making himself the laughing-stock of the learned world." With reference to M. Bouillaud's demand for a *phonograph which can think*, the writer adds:—"Since age has weakened an intellect which was once the luminary of French medical science, why exhibit the softening, the decay, of a brain so admirably organised."]

Berichte der Deutschen Chemischen Gesellschaft zu Berlin. No. 10, 1878.

Contributions to the Steric Law.—H. Schröder.—The author exemplifies this law as regards the sulphides and arsenides of iron, cobalt, nickel, copper, zinc, and lead. He remarks that the modifications of arsenic and of its acids, which he describes along with the sulphides and arsenides, form so brilliant a confirmation both of the law of condensation and of the steric law that the validity of both may be assumed with the greatest probability.

Variation of the Absorption Spectra of certain Colouring-Matters in Different Solvents.—F. v. Lepel.—The author states that, when observing the reactions of purpurin-alumina and purpurin-magnesia, he had the opportunity to convince himself of the heterogeneous character of the purpurin spectra, according as one of the above-named compounds or an alkali was present, or according to the nature of the solvent. His attention was first excited by the appearance of a new absorption-band after the addition of a very little alkali to the pure alcoholic solution. The strange behaviour of purpurin induced him to examine the optical behaviour of a series of dyes in different solvents. Kundt proposed the law (*Pog. Ann. Jubelband*, p. 615) that an absorption-band of a colouring-matter moves so much farther towards the red the greater the refractive index of the solvent employed. A large number of dye-wares confirm the correctness of this law most distinctly. But it cannot be denied that the spectra of certain colouring-matters undergo no change, whilst the index of refraction increases, and in other cases the band is removed towards the violet, and in others again the character of the spectrum is completely altered. Hence, as Vogel recently declared, we cannot expect to observe the characteristic absorption-bands of a colour under all circumstances. The author in his experiments employed acid, neutral and alkaline, the neutral solvents being water, ether, alcohol, chloroform, and bisulphide of carbon—a series in which each member has a greater refractive power than the foregoing. The authors' results cannot be given without the accompanying diagram.

On Didymium and Lanthanum.—F. Frerichs.—A reply to the criticism of Cleve on the author's paper on didymium and lanthanum.

Oxidation Products of Hexylen obtained from Mannite.—Otto Hecht.—The author, repeating the experiment of Chapman and Thorp on the action of chromic acid upon β.hexylen, obtained not as they state, carbonic, acetic, and propionic acids, but, in place of the last-mentioned, normal butyric acid. He has further examined the behaviour of hexylen with dilute sulphuric acid.

Oxidation Products of the Hexylen-glycol obtained from Mannite.—O. Hecht and J. Munier.—The acid srecognised were the normal butyric and the acetic.

On Ortho-dinitro Conpounds.—A. Laubenheimer.—The author examines the behaviour of ortho-dinitro-benzol with ammonia, that of dinitro-chlor-benzol with amido-derivatives, and that of dinitro-brom-benzol with soda.

On Metachlor-phenol.—E. Uhlemann.—This compound boils at 211° to 212°, and congeals on cooling to a white crystalline mass, which, after being drained by pressure, melts at 28·5°.

On Conchinin Sulphate.—O. Hesse.—As conchinin sulphate is not capable of transformation into quininiferous cinchonidin sulphate, it follows that Shaer's experiments refer to Winkler's quinidin sulphate, and not, as he maintained, to that of Pasteur.

Action of Melting Potassa upon Glycerin.—Erwin Herter.—The author obtained by this reaction acetic, formic, and butyric acids, and the lactic acid of fermentation.

Action of the Halogen-Sulphur Compounds upon Aniline, and of Sulphur Chloride upon Acetanilid and Benzol.—E. B. Schmidt.—With the object of discovering a convenient process for the preparation of the mono-sulpho-bases of the aromatic series, the author has examined the behaviour of aniline with sulphur iodide, bromide, and chloride; that of acetanilide with sulphur chloride; that of benzol with the same compound, and of sulphur chloride and benzol in presence of zinc. As the result of his researches, he finds that halogen-sulpho-compounds act upon aniline in such a manner that the whole of the sulphur is fixed, with the formation of di- and probably of tri-sulpho compounds, the yield of monothio-anilin being small.

Formation of Crude Corallin.—P. Gukassianz.—The author considers that neither carbonic oxide nor carbonic acid is the agent of the reactions, but that the oxalic acid, as such, enters into reciprocal action with 2 mols. phenol, 2 mols. of water being eliminated, and $C_{14}H_{10}O_4$ being first formed.

Action of Oxalic Acid upon Resorcin.—P. Gukassianz.—The author obtains two colouring-matters, both of the composition $C_{14}H_{10}O_6$.

A New Method for the Quantitative Determination of Sulphur.—O. Fahlberg and M. W. Iles.—If sulphur is fused with a sufficient excess of alkali it is converted entirely into sulphite, and not into a mixture of hypo-sulphite and sulphide, and if still more alkali is present the result is a mixture of sulphite and sulphate. To oxidise the sulphite to sulphate the authors apply bromine. They have successfully applied this analytical principle to organic sulphur compounds, to free sulphur, and metallic sulphides. The fusion of sulphur or a metallic sulphide with potassa yields a sulphite without any loss, which is then oxidised by means of bromine and hydrochloric acid, forming sulphuric acid, which is then determined in the ordinary manner. Where metallic oxides are separated after the fusion in an insoluble state, they are removed by filtration before the bromine and hydrochloric acid are added. Sulphides of arsenic, antimony, zinc, &c., all yield, after melting, a fusible mass, whilst in case of sulphides of iron and copper these metals are left behind in the state of oxides. Even in pyritic silicates the sulphur can be accurately determined in this manner. Care must be taken that not less than 25 grms. pure caustic potassa is taken to every 0·1 grm. of sulphur supposed to be present. The operation is performed in a silver crucible, and the fusion is continued till the mixture becomes tranquil—say from fifteen to twenty minutes—or till vapours of alkali begin to condense along the upper part of the crucible, which after use shows a clean surface if sufficient alkali has been used. When cold the mass is dissolved in cold water, freed from oxides, &c., by filtration, mixed with from 75 to 100 c.c. bromine water and hydrochloric acid, added till a distinctly acid reaction is obtained. Heat is then applied till the liquid is colourless.

Neutral Ethylic Ether of ordinary Nitrophthalic Acid, and of the Oxyphthalic Acid of A. Baeyer.—O. Miller.—The pure neutral ethylic ether of ordinary nitrophthalic acid is easily obtained from the silver salt of this acid by the action of ethyl iodide in the water-bath, and appears as a colourless crystalline body, which melts at 43°.

Action of Ammonia upon Acet-acetic Ether.—H. Precht.—This compound was discovered by Geuther, who regarded it as an acid, and named it ethyl-diacetic acid.

By the action of ammonia the author obtained an amide of the composition $C_6NH_{11}O_2$, water being eliminated.

Specific Gravity of the Vapours of the Chlorides of Thallium and Lead.—H. E. Roscoe.—Seven experiments with chloride of thallium gave 8·15, 8·28, 8·06, 7·43. 8·75, 8·60, 7·84; the calculated sp. gr. being 8·49. With chloride of lead the experimental results were 9·12, 9·72, 9·51, 9·64; calculation showing 9·62.

On Isodulcite.—R, S. Dale and C. Schorlemmer.—The authors having treated quercitrin with hydriodic acid found it converted into a tarry mass, while a heavy iodiferous liquid distilled over, from which they did not succeed in separating any definite body.

On Ethylidenimid Silver Nitrate.—A. Goldschmidt.—If to the alcoholic solution of 1 vol. aldehyd there is added ½ vol. ammonia, and the solution of nitrate of silver is added without shaking the vessel, this compound is slowly deposited in beautiful nacreous leaflets. The properties of this body agree with those of ethylidenimid silver; it is sparingly soluble in water, alcohol, and ether, but readily in ammonia. If boiled with water it deposits silver in a specular layer.

On Chlornaphthylamin.—P. Seidler.—If naphthylamin, prepared according to Roussin's method, is exposed to the air for some weeks along with the mixture of stannous chloride and hydrochloric acid, it is partially converted into chlornaphthylamin. If heat is applied to the mixture the amide group is attacked, and colouring-matters are formed.

Oxidation of certain Nitrogenous Compounds by means of Permanganate of Potassa.—S. Hoogewerff and W. A. Van Dorp.—Aniline yields oxalic acid, almost a fourth of its carbon being oxidised. Azo-benzol is also produced. Ortho-toluydin treated in the same manner yields also oxalic acid and azo-toluol, a beautiful red compound which crystallises from ether in well-formed prisms, and melts at 55°. About 50 per cent of the nitrogen present in in the ortho-toluydin reappears as ammonia. In para-toluydin only about 40 per cent of the nitrogen is obtained as ammonia. Para-azo-toluol was also obtained, as a body insoluble in the oxidising liquid. The yield of oxalic acid is relatively smaller than in the former cases.

Lemon-yellow Nitro-benzoic Acids.—F. Fittica.—The author has obtained and examined the sulphated diazo-benzoic acids corresponding to the above acids.

Decomposition of Petroleum and Lignite Tar by Superheating.—A. Letny.—The author claims priority as against Liebermann, Burg, Salzmann, and Wickelhaus. He passed residues from Baku petroleum (sp. gr. 0·87; boiling-point, 270°) through an ignited horizontal retort, 7 feet in length by 1 foot in diameter, and filled with wood-charcoal. The products submitted to dry distillation began to boil at 80°, yielding up to 90° benzol (4·6 per cent); up to 145° toluol and its homologues (5·2 per cent); up to 340° naphthalin and unchanged petroleum (35·5 per cent). The portion boiling above 340° was received in three parts: *a*, phenanthren 2·7 and petroleum 9·3 per cent; *b*, anthracen 2·4 and petroleum 5·2 per cent; *c*, anthracen 1·94 and petroleum 6·04 per cent. Besides petroleum and lignite tar the products of the dry distillation of natural asphalte, of resinous shales, and the last residues from the refining of petroleum can be decomposed into aromatic hydrocarbons.

TO CORRESPONDENTS.

ERRATA.—In the CHEMICAL NEWS of October 18, p. 191, bottom of col. 1, read—

$$NaNO_2 = NaNO_3 + O.$$
$$2NaNO_2 + H_2O = 2(NaHO) + N_2O_3.$$
(Dissociation of the Salt.)
$$N_2O_3 + Fe = FeO + N_2O_2.$$

J. Taylor.—Thanks for your letter. In the passage to which you take exception the writer evidently referred to a special case. No practical result would follow from further discussion, especially as the circumstances probably vary in the several districts.

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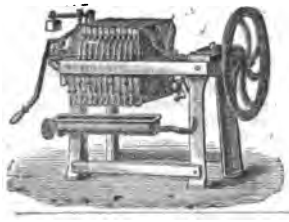

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 988.

ON YTTERBIA, A NEW EARTH CONTAINED IN GADOLINITE.

By M. C. MARIGNAC.

At the close of the researches on the gadolinite earths—which I had undertaken for the purpose of confirming M. Delafontaine's observations on the existence of terbia and of a new base belonging to the same group, and to which he has given the name of philippia—I obtained a few grammes of an earth presenting all the characteristics of erbia, as set forth by MM. Bahr and Bunsen and MM. Cleve and Hoglund. I ought, however, to mention that the method by which I separated it from the other gadolinite earths was not in all respects identical with that which those *savants* employed. Bunsen's method consists in heating the combined nitrates till red vapours appear, when they are re-dissolved in boiling water, and on cooling the nitrite separated. This nitrite is rich in erbia, which is deposited in little acicular crystals. I myself continued the decomposition of the nitrates until the mass assumed a pasty condition. On treating this mass with boiling water an insoluble residue remains, in which the erbia is concentrated. By repeating one or other of these methods many times an earth of a pure rose colour is obtained, which constitutes erbia.

In my first experiments I discontinued this treatment as soon as I had succeeded in obtaining a rose-coloured earth, the equivalent of which, between 128 and 129,* corresponded to that assigned to erbia.†

More recently I have collected the products thus obtained with the object of ascertaining whether by continuing the same operations I should obtain an increase of the equivalent. In doing this I observed a fact which surprised me much.

During the first part of my work, the gradual increase of the equivalent corresponded to an increased intensity of the rose colouration and of the absorption-bands characteristic of erbium. After a certain point had been reached the equivalent still continued to rise slowly, but the rose colouration and the absorption-bands diminish rapidly, so much so that the last product obtained gave no absorption-rays; it was perfectly white, and its salts were colourless.

The equivalents of the last three products obtained were 130·4, 130·6, and 130·8. The first two still showed a distinct rose colouration, especially in the case of the crystallised oxalates and sulphates. If a sufficient quantity of material were operated upon to admit of this method of purification being extended still further 131 might be taken approximately as the extreme limit of the equivalent.

It evidently follows that the earth which I had extracted from gadolinite, and which I had considered as erbia, was in reality a mixture of two distinct oxides. The one, which was of a pure rose colour, and which gave a very characteristic absorption-spectrum, should retain the name of erbia, as it contains the most distinctive characteristics of that earth. The other is a new earth belonging to the same group, for which I propose the name of ytterbia, not only by way of alluding to its presence in the mineral of Ytterby, but on account of its resemblance to yttria by its whiteness, on the one hand, and to erbia by the elevation of its equivalent on the other, as well as by the resemblance to the latter earths in most of its properties.

The small quantity of material I have had at my disposal has not admitted of my making a complete study of its properties. The following are, however, a few indications which establish its individuality.

I have already referred to its perfectly white colour: its salts are colourless, and the nitrate is decomposed by the aid of heat without being coloured.

The solutions of ytterbia give no absorption-rays neither in the ordinary spectrum nor in the ultra-violet, according to the observations which M. L. Soret has made. In the purest sample that I have been able to obtain, hardly a trace of the strongest erbia ray could be discerned in the yellow green.

Ytterbia is less easily acted upon by acids than the other earths of this group. It dissolves slowly in dilute acids either cold or moderately heated. It always dissolves easily in boiling dilute acids, even in acetic and formic acids.

Its sulphate exactly resembles those of yttria and erbia. It is most probably isomorphous with them, for the solutions containing ytterbia and erbia give to the last only one kind of crystal always presenting the same appearance, their colour varying only as they contain more or less erbia.

The sulphate is easily re-dissolved without deposit in a saturated solution of potassic sulphate. No precipitate is formed even when the solution is boiled.

A neutral solution of ytterbic chloride, if it is not too concentrated, is not precipitated by boiling with sodic hyposulphite. If the solution is very concentrated, and contains both erbium and ytterbium, a precipitate is obtained which is richer in erbium than the earths remaining in solution.

Ytterbium precipitated from its salts by potash, and submitted to a current of chlorine in presence of an excess of potash, is completely re-dissolved.

The formiate dissolves in less than its weight of water; it crystallises in the mamillary form like the formiates of yttria and erbia. Like them it is decomposed and tumefied by heat; it presents the same composition corresponding to the formula $Yb_2O_3,3C_2H_2O_3+4H_2O$. It also loses its water of crystallisation at 100°.

All these characteristics sufficiently establish the fact that this earth contains no thoria, the only earth amongst those known, or which may be supposed to exist, whose equivalent would be sufficiently elevated for its presence to account for the increase in that of erbia.

The fact of this new earth being so difficult to separate from erbia may give rise to many doubts as to the exactness of the equivalent attributed to this latter earth. If I trusted to observations made on too small quantities of material to be conclusive, I should be led to believe that that equivalent is much too high. It seemed to me, indeed, that the maximum of rose colouration and of the intensity of the absorption-spectrum corresponded to products whose equivalent was comprised between 122 and 126, but which were, however, only mixtures of erbia and ytterbia.

Can it be admitted that Bunsen's method for the purification of erbia by the crystallisation of the nitrite led to the elimination of ytterbia, so that the erbia experimented upon by the German and Swedish *savants* was exempt from it.

The difficulty of procuring gadolinite in sufficient quantity, and the great length of time necessary to extract the erbia from it, and which after all is found in it only in very small quantity, leave me scarcely any hope of being able to solve these questions and to establish in a more complete manner the properties of ytterbia. It is on this account that I was desirous of calling the attention of chemists to these facts, and especially of those who have experimented upon a sufficiently large quantity of erbia, and who may possess some still, hoping that they will prosecute researches on this subject, and assure themselves of the existence of the new earth, which to my mind is thoroughly established.

* Equivalent calculated for the formula EaO, or, more probably, Ea_2O_3, and for O=16.

† 128·5 according to Bahr and Bunsen, 129·7 according to MM. Cleve and Hoglund.

Adopting provisionally for ytterbia the equivalent 131 we deduce for the atomic weight of ytterbium the value 115, or 172·5, according as the formula YbO or Yb_2O_3 is attributed to its oxide.—*Comptes Rendus.*

LABORATORY NOTES FROM THE UNIVERSITY OF CINCINNATI.

By F. W. CLARKE, S.B., Professor of Chemistry.

Some Specific Gravity Determinations.

The following specific gravity determinations represent work done by my students and myself during the school year 1877-78. Those portions of the work which were entrusted to students were carried out under my immediate supervision, and every precaution was taken to ensure a fair degree of accuracy. The salts were all weighed in benzol, and the figures refer to water at its temperature of maximum density as unity.

To Mr. W. H. Creighton and Mr. E. F. Wittmann I assigned mercuric cyanide and some of its double compounds. For the cyanide itself, $HgCy_2$, we found a sp. gr. of 4·0262 at 12°, Creighton; 4·0026 at 22·2°, Wittmann; and 4·0036, 14·2°, F. W. Clarke.*

For the oxy-cyanide, $HgCy_2HgO$, Mr. Creighton found 4·437 at 19·2°, and I myself in two determinations, 4·428 and 4·419 at 23·2°.

For the double salt, $HgCy_2HgCl_2$, Mr. Wittmann obtained the values 4·531, 21·7°, and 4·514, 26°.

For the double cyanide of mercury and potassium we have, from experiments made by Mr. Creighton, 2·4470, 21·2°; 2·4620, 21·5°; and 2·4551, 24°. This salt is the well known $2KCy.HgCy_2$.

Mercuric bromide, prepared by Mr. Miles Beamer, gave 5·7461, 18°, and 5·7298, 16°.†

The double bromide of mercury and potassium was also prepared and examined by Mr. Beamer, both in the hydrated and the anhydrous state. For the salt $HgBr_2,KBr$, he found 4·412, 17·2°; 4·419, 24·5°; 4·3996, 20·5°. For the hydrated salt, $HgBr_2.KBr.H_2O$, as a mean of six concordant determinations taken between 20° and 24°, he found a sp. gr. of 3·867. The potassium bromide used in these preparations gave a sp. gr. of 2·712, 12·7°.‡

Mr. Beamer also re-determined the sp. gr. of the curious double salt $(NH_4)_2Cr_2O_7.HgCl_2.H_2O$, finding it to be 3·329, 21°.

Mercuric iodide and a couple of double salts were determined by Miss Mary E. Owens. For HgI_2, the mean of seven experiments between 10° and 19°, is 6·231.||

For the double iodide, $2(KI.HgI_2).3H_2O$, the sp. gr. is 4·289, 23·5°; and 4·254, 22°.

For the iodide of mercury and tetramethyl-ammonium, $N(CH_3)_4I.HgI_2$, were found the values 3·968, 24°; 3·976, 23·5°; 3·971, 24°; 4·003, 23·2°. The iodide of tetramethyl-ammonium itself, well crystallised, was found by Miss Owens to have a sp. gr. of 1·827, 17°; and 1·831, 19·5°.

Cadmium chloride and some of its double compounds were examined by Mr. Walter Knight.

The anhydrous chloride, $CdCl_2$, gave as a mean of three determinations the value 3·938, 23°.§ The hydrated salt, $CdCl_2.2H_2O$, gave a sp. gr. of 3·339, 18·2°; 3·320, 23·2°; 3·314, 23·6°.

The double chloride of cadmium and strontium,—

$$2CdCl_2.SrCl_2.7H_2O,$$

in fine crystals, as a mean of three experiments, was found to have a sp. gr. of 2·718 at 24°.

And the barium salt, $CdCl_2.BaCl_2.4H_2O$, gave the values 2·952, 24·5°; and 2·966, 25·2°.¶

Several salts of acids belonging to the xanthic acid series were prepared by students under the direction of Professor R. B. Warder, and of these, three well-crystallised examples had their sp. gr. determined.

Potassium methyl-disulphocarbonate, $K.CH_3.COS_2$, prepared by Mr. E. P. Bishop, has a sp. gr. of 1·7002 and 1·6754 at 15·2°.

Potassium ethyl-disulphocarbonate was determined by Miss Helena Stallo and by Dr. J. P. Geppert. Miss Stallo found the sp. gr. to be 1·5564, 18·2°; and 1·5576, 21·5°. Dr. Geppert's determination gave 1·558, 21°.

Potassium isobutyl-disulphocarbonate, also determined by Miss Stallo, has a sp. gr. of 1·3713, 15°; and 1·3832, 14·5°.

A particularly interesting series of observations was made by Miss Stallo upon the formates and acetates of cobalt and nickel. I am unable to find any adequate account of these salts beyond the mere fact that they form crystalline crusts. Even the water of crystallisation in them seems hitherto not to have been determined. Miss Stallo prepared these compounds by dissolving the carbonates of the metals in the respective acids, estimated the water contained in them, and determined the density. The formates of cobalt and nickel crystallise with two molecules, and the acetates with four molecules of water. The sp. grs. are as follows:—

Cobalt formate	..	2·1286, 22·0°; 2·1080, 20·2°.
Nickel ,,	..	2·1547, 20·2°.
Cobalt acetate	..	1·7031, 15·7°; 1·7043, 18·7°.
Nickel ,,	..	1·7443, 15·7°; 1·7346, 17·2°.

Miss Stallo also prepared, with a view to future description, the cobalt and nickel salts of monochloracetic and trichloracetic acids. These salts are readily crystallisable, and seem likely to be interesting. Cobalt valerate, which Mr. J. L. Davis attempted to prepare, was obtained by him only as a red, gummy mass, of a very unsatisfactory character.

Another series of experiments having a certain theoretical interest, relates to some salts analogous to the sulphovinates. The data obtained are as follows:—

Barium methyl-sulphate, $Ba(CH_3)_2(SO_4)_2.2H_2O$, 2·273, 19·2°; and 2·279, 21·2°, determined by Dr. Geppert.

Barium ethyl-sulphate, 2·080, 21·7°; 2·0714, 22·6°; Dr. Geppert.

Barium propyl-sulphate, 1·839, 20·5°; 1·844, 20·5°; Dr. Geppert.

Barium isobutyl-sulphate, 1·778, 21·2°; 1·743, 24·2°; Mr. W. H. Schuermann.

Barium amyl-sulphate; 1·623, 21·2°; 1·632, 22°; Mr. John Whetstone.

If, now, we calculate the molecular volumes of these salts, we shall find them separately by approximately equal differences. If we assume these differences to be really equal, and distribute the experimental error among the several salts, we can get the following interesting series of theoretical values.

Methyl-sulphate,	molec.	vol.	176,	calc.	sp. gr.	2·244
Ethyl-sulphate	,,	,,	209,	,,	,,	2·024
Propyl-sulphate	,,	,,	242,	,,	,,	1·863
Isobutyl-sulphate	,,	,,	275,	,,	,,	1·780
Amyl-sulphate	,,	,,	308,	,,	,,	1·646

These calculated values correspond to a supposed constant difference in the molecular volume, of 16·5 for each CH_2 group; a difference which holds in a great many series of compounds. This difference may also be made out, within narrow limits of approximation, in the series of sulphocarbonates previously given. Here, for example, we have, very nearly,—

Methyl salt,	molec.	vol.	88,	calc.	sp. gr.	1·658
Ethyl ,,	,,	,,	104·5,	,,	,,	1·531
Isobutyl ,,	,,	,,	137·5,	,,	,,	1·367

It will be seen that all these calculated specific gravities agree closely with those actually found; and that, curiously enough, the molecular volumes thus assumed are exact multiples by whole numbers of Kopp's well known value

* Bödeker, *Jahresberichte*, 1860, gives for $HgCy_2$ the value 3·77, 13°.
† Karsten, *Schweigg. Journ.*, v., 65, gives 5·9202.
‡ Schröder's mean value for this salt is 2·690. *Pogg. Ann.*, 1859.
|| Filhol, *Ann. d. Chim. et Phys.*, III., xxi., 1847, gives 6·250.
§ Bödeker gives a sp. gr. of 3·6254, 12°. *Jahresberichte*, 1860.
¶ Topsöe, *Chem. Centralblatt*, iv., 76, found 2·968

for hydrogen, 5·5. Are these regularities mere coincidences, or do they indicate the existence of some general law?

I may give, in conclusion, a few determinations of specific gravity made by myself.

Potassium chloroplatinite, $PtCl_2.2KCl$, 3·2909, 21°; and 3·3056, 20·3.

Telluric acid, crystallised, $H_2TeO_4.2H_2O$, 2·9999, 25·5°; and 2·9649, 26·5°.*

Telluric acid, H_2TeO_4, 3·425, 18·8°; 3·458, 19·1°; 3·440, 19·2°.

Ammonium tellurate, $(NH_4)_2TeO_4$, 3·024, 24·5°; 3·012, 25°.

Thallium Tellurate.—For this compound, hitherto undescribed, I can give only a few preliminary facts. By a series of mishaps my material became exhausted, so that I was unable to complete the investigation of the substances obtained. Metallic thallium is not attacked even by a boiling solution of telluric acid. When, however, a solution of ammonium tellurate is added to one of thallium nitrate, a heavy white precipitate falls, somewhat resembling silver chloride. This precipitate dried at 100° has a sp. gr. of 5·687, 22°; and 5·712, 20°. Heated to about 180° it turns to a pale straw-yellow colour, and loses 1·46 per cent of water. The sp. gr. of this yellow salt is 6·742, 16°; 6·760, 17·5. Heated to redness, the thallium tellurate fuses, and is reduced to tellurite. This, when hot, is almost black, but solidifies on cooling to a clear lemon-yellow glass. The exact composition of these salts remains to be determined, and I hope to return to them at some future time.—*American Journal of Science.*

ON THE ALBUMINOID MATTERS, ALCOHOL, AND PHOSPHATES IN THE BURTON ALES AND IN DUBLIN PORTER.†

By REGINALD LAWRENCE and C. W. REILLY,
Associates of the Royal College of Science.

THE two kinds of malt liquor, Burton ale and Dublin porter, are so largely consumed at the present time, that it appeared to us desirable to have the three classes of Dublin porter, as manufactured by Messrs. Arthur Guinness and Son, and the Burton ales, manufactured by the two most noted brewers, Messrs. Bass and Allsopp, examined under the same conditions.

The samples of the Burton ales examined we obtained from Messrs. Falkner, of this city, and we are greatly indebted to the kindness of Messrs. Arthur Guinness and Son for supplying us with the samples of porter we required for our investigation.

We confined our examination to the estimation of the principal constituents:—The phosphoric acid existing in the form of phosphates, the albuminoid matter and alcohol, together with the acetic acid, the total amount of solid matter, and the specific gravities of the different samples.

The phosphoric acid was determined in the ash by a standard solution of acetate of uranium; in the estimation of the albuminous matter, acetic acid, alcohol, and total solids, we followed the plans given by Messrs. Jackson and Wonfor.*

We may add that the quantity of albuminous matter was determined by first finding the amount of nitrogen by Will and Varrentrapp's method, and then taking 15·92 parts of nitrogen as equal to 100 parts of albumen.

Our investigations show that some of the principal elements of nutrition are present in larger quantities in the foreign and ordinary Dublin double stout than in the Burton ales.

This investigation was carried on in the laboratory of the College of Science, under the direction of Professor Galloway.

The quantities of the substances we estimated, expressed in grains per gallon, are given in the table below.

		Bass's Ale.	Allsopp's Ale.	Foreign Double Stout.	Double Stout.	Guinness's Single Stout.
Albuminoid matter	1st Estimation	333·2404	327·1731	574·0000	435·303	298·996
	2nd Estimation	340·5217	316·7365	549·6250	422·112	316·584
	Mean	336·8810	321·9548	561·8125	428·708	307·790
Acetic acid ..	1st Estimation	95·9280	168·2100	261·7860	139·300	160·580
	2nd Estimation	96·1310	167·9000	255·7058	147·000	160·090
	Mean	96·0295	167·0500	258·7409	143·150	160·335
Alcohol		4383·4000 4365·9000 4374·6509	4478·5125 4443·8625 4461·1875	5128·2000	4643·100	3534·300
P_2O_5		19·4250	18·3750	123·1100	111·088	85·600 79·829 82·715
Total solids		4884	3110	4374	5068	3838·5
Specific gravities		1·0138	1·0144	1·011157	—	1·12438

* Oppenheim, *Jahresberichte*, x., 213, gives 2·340.
† A Paper read before the Royal Irish Academy.

* Messrs. Jackson and Wonfor "On the Composition of the Dublin Porter."—*Journal of the Royal Dublin Society*, vol. iii., page 163.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 15, 1878.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President, in the Chair

MR. BINNEY, F.R.S., F.G.S., said that at a meeting of the Society, held on the 14th day of November, 1876, he gave an account of a *Eucalyptus globulus* growing in his garden at Douglas, in the Isle of Man. In that year (1876) it had grown 7 feet 8 inches in height; in the following year 6 feet 8 inches, when it unfortunately lost its leading shoot by accident. Up to the 7th of this month it had grown 6 feet. Thus in the three years it had reached 20 feet 4 inches in height. The tree was planted in a sheltered situation close to the sea, and its foliage at the present time, notwithstanding the recent severe gales, presents a most luxuriant appearance and yields a pleasant odour. No manure has been supplied to the roots, which have grown in a soil formed of the *débris* of Manx schist.

"*Relative Brightness of the Planets Venus and Mercury*," by JAMES NASMYTH, C.E., F.R.A.S., Corresponding Member of the Society.

On many occasions, when observing Mercury and Venus in full daylight, I have always been impressed with the

strikingly inferior brightness of Mercury as compared with Venus; and as such a condition is the very reverse of what might be expected by reason of Mercury being so much nearer to the sun than Venus, I awaited the rare event of a very close conjunction of these two planets that occurred on the 26th and 27th of September last. With the advantage of a perfectly clear sky I had the two planets before me for several hours, so to speak, side by side in the field of the telescope at the same time, thus affording me a most perfect opportunity for making a comparison of their relative brightness. It is difficult to convey in words an exact impression of the difference in the brightness of such objects, but I may attempt to do so by stating that Venus looked like clean silver, while Mercury looked like lead or zinc. Were I to indicate my impressions by way of number I would say that Venus was fully twice as bright as Mercury. So remarkable an inferiority in the brightness of Mercury, notwithstanding his much greater nearness to the sun, appears to me to indicate the existence of some very special and peculiar condition of his surface in respect to his capability of reflecting light—a condition that may be due to the nature of his envelope, if such exist, or of that of his surface, by which the fervid light of the sun's rays falling on him are in a great measure quenched or absorbed so as to leave but a small residue to be reflected from his surface. If this be so, it appears to me to be reasonable to suppose that the absorption of so much light must result in a vast increase in the heat of the surface of Mercury beyond what would have been the case had Mercury possessed the same surface conditions as Venus. Whether in the progress of spectroscopic investigation we shall ever be enabled to detect some evidence of metallic or other vapours or gases clinging to or closely enveloping the surface of Mercury that might in some respect account for so remarkable an absorption of the sun's light, we must be content to await the acquirement of such evidence if it ever be forthcoming. It appears to me, however, to be well to raise such a question, so that our astronomical spectroscopists may be on the outlook for some evidence of the cause of so very remarkable a defective condition in the light-reflecting power of Mercury to which I have thus endeavoured to direct attention.

"*On the Water of Thirlmere*," by HARRY GRIMSHAW, F.C.S., and CLIFFORD GRIMSHAW.

The samples of water of which the following details are given were taken by us on August 23rd, 1878, from what may be termed the "upper and lower lakes," meaning above and below the narrow waist of the lake, where crossed by the small bridge. The first taken was the "lower" sample, which was obtained on the west side of the lake about 20 yards below the bridge. The "upper" sample was taken about three-quarters of a mile below the head of the lake on the east side. The results of the two samples, so far as position affects them, should therefore be sufficient to show any possible divergency which could occur in the quality of the water on that account. These two positions are shown upon the sketch map accompanying the paper.

The two samples were analysed separately, except as regards the amounts of ammonia (determined August 28th), for which equal parts of each sample were taken, as there was not a sufficient quantity for separate analyses.

The following are the numbers obtained :—

Free ammonia—half a litre of water distilled took 1·5 c.c. standard NH_4Cl.

Albuminoid ammonia—half a litre of water distilled took 3 c.c. standard NH_4Cl.

Total hardness—70 c.c. water took 1 c.c. standard soap solution.

Permanent hardness—70 c.c. water boiled one hour and made up took 1 c.c. soap. (The ammonia analysis common to both samples, hardness same in each.)

Solid matter—100 c.c. lower sample gave 0·0045 grm. residue, which blackened on ignition, and lost 0·0025 grm.

Solid matter—70 c.c. upper sample gave 0·0022 grm. residue, which blackened a little on heating, not so much as lower sample, and lost on ignition 0·0007 grm.

Chlorine—25 c.c. lower sample took (1st) 0·25 c.c., (2nd) 0·25 c.c. standard $AgNO_3$; 25 c.c. upper sample took (1st) 0·15 c.c., (2nd) 0·15 c.c. standard $AgNO_3$.

The foregoing figures give the following tabulated results :—

	Grains per Gallon.		
	Lr. Sample.	Up. Sample.	Dr. Roscoe's
Total solid matter ..	3·15	2·20	1·4500
Mineral matter	1·40	1·50	—
Loss on ignition	1·75	0·70	—
Total hardness	1·00	1·00	0·5000
Permanent hardness ..	1·00	1·00	0·5000
Chlorine	0·70	0·42	0·4200
Nitrogen as nitrates and nitrites	—	—	0·0247
Free ammonia	0·0021		—
Albuminoid ammonia..	0·0042		0·0049

The "ammonias" expressed in parts per million are 0·03 and 0·06 respectively; the chlorine equals 0·7 and 1·16 grains per gallon of salt.

The water was very clear and sparkling, practically free from sediment, and its reaction perfectly neutral to litmus. There was no reaction for heavy metals, copper, lead, iron, &c., although we observed that there ran in close to the top of the lake a small stream of a very turbid milky appearance, upon which is situated, on the side of the hill towards Helvellyn, a lead mine; which stream could be traced by its colour for at least 20 yards into the clear water of the mere. These mining operations, we understand, will of course be completely done away with on proceeding with the water scheme.

We may offer the following brief remarks upon the above analysis of the water of Thirlmere. In the first place it is evident that the water is one of the very purest description found in nature, not being surpassed by that of any locality in Great Britain of which analyses have been published.

As regards its use for manufacturing purposes it practically could not be improved. For drinking purposes, also, it is perfectly free from anything which could be considered objectionable, of either an organic or mineral nature, though we are not prepared to assert that a water, considered "solely" as to its suitability for this purpose, attains any particular advantage from having its amount of lime salts lower than some ten or so grains per gallon, though doubtless it is better that this should be very small than that it should be excessive. To give a fuller indication of the quality of the water of Thirlmere, we have taken the liberty of appending to our results those obtained by Dr. Roscoe from a sample of the same taken in February of this year. Now it will be seen that there is a certain difference between the results of these samples, more especially with regard to our "lower" one. On examination, however, the difference will be seen to be one of "degree" only, and not of "kind," and entirely confined to the mineral, and in this case the least important items. It is explained by the fact that the rainfall some little while before the taking of the respective samples had been very different, the longest period of dryness perhaps which we have had this year having occurred just before the taking of those of the present paper. We should therefore expect that the solid matters would be higher, and find them to be so by about 1½ grains per gallon, the total in either case being insignificant. It would perhaps not be wide of the mark if we said that the analyses of Dr. Roscoe and ourselves show the water at its best and its worst as regards ordinary variation. This variation, it will be seen, is not greater than may occur at the same time in different parts of the lake, as shown by our upper and lower samples, these analyses also indicating a slight gradual increase of dissolved ma-

terial as we approach the foot of the lake, where the solvent action of the water upon its bed will have accumulated and the fresh water received from the tributaries is lowest in amount. This gradation of quality will, of course, only be true of the lake under its present natural conditions.

The variation of the organic constituents of the water at the different dates is not so marked. From the behaviour of the solid matter during ignition we should say that the carbonaceous matter, of which there is a perceptible amount, is almost entirely of a vegetable nature.

NEWCASTLE CHEMICAL SOCIETY.

October 24, 1878.

Inaugural Address, by R. C. Clapham, F.C.S.

In the first place it is my duty to thank the members for the honour they have conferred upon me by electing me to be their President. This post has been filled in past years by former Presidents who have conducted the business of the Society with great ability and skill. I must therefore ask the indulgence of the members for any deficiencies on my part whilst continuing to discharge the duties they have called upon me to undertake. Let us, at the outset, glance backwards for a moment to the beginning of the Newcastle Chemical Society in 1868. At that time there was no recognised means of communication between chemists in their immediate districts; purely scientific chemists, manufacturing chemists, and the large number of young chemists in laboratories on the Tyne, were each pursuing their daily investigations without the frequent exchange of ideas which is not only necessary to success, but which forms a pleasant social bond of union between all scientific men. This Society's importance as a source of instruction and information to chemists cannot be exaggerated; it has at present every prospect of a great and useful future before it; and as time goes on its members will increase, and its influence as a scientific Society will be proportionably extended.

I do not wish to forget that we have also in this locality a junior Chemical Society which I have pleasure in acknowledging has shown for several years much youthful vigour and ability both in the papers read and in its general administration. I am sanguine enough to think, as I have before expressed, that the time will soon come when it will be to the interest of both Societies to amalgamate, and so form one united and strong body.

Mr. Gossage.

In the Committee's Reports which have been hitherto issued I believe that no reference has been made to the deaths of members. A record of the deaths, and in some cases a short account of the lives, is now prepared by most scientific bodies. Although reference was made in last year's Address (but which was not published) to the death of one of our most eminent members,—Mr. Wm. Gossage,—I may be excused for adding a few remarks on Mr. Gossage's career as a chemist from personal knowledge of my lamented friend's life. Mr. Gossage was born in 1799, and the earlier part of his life was spent at a time when many of the great discoveries in reference to the metals and gases were being made by the fathers of our present chemistry—discoveries which made this science at the time peculiarly attractive to young men of genius. Occupied for a time in a small druggist's shop in Chesterfield, with none of the means that are now to be found at the disposal of chemists, he may be said to have mastered the principles of chemistry which he was able practically to apply shortly afterwards as manager of alkali works at Stoke Prior, in Worcestershire. Up to that time no practical method was known, although many attempts had been made, to condense hydrochloric acid gas, and Mr. Gossage here first tried and then patented a system of condensation by means of his now well-known stone towers, or condensers, which have proved so successful for the last fifty years. He was one of the first to set about the recovery of the waste manganese in making bleaching-powder, for which several patents were taken out, one of which closely foreshadows Mr. Weldon's now successful process. In various extensive experiments for the recovery of sulphur from soda waste much time and money were expended. With the extraction of the small percentages of copper in burnt ores of Irish and Cornish pyrites, with the manufacture on a large scale of the new silicate soap, and with a long series of experiments for improved methods of producing pure soda, free from sulphides and cyanides, his memory and name will always be associated. Mr. Gossage was a hard and earnest worker, and to those who visited at his house at Widnes a genial and sincere friend. The young student of the present day, who has the easy means at his disposal for acquiring chemical knowledge at our local schools, colleges, and laboratories, must not forget the great difficulties and discouragements with which the old pioneers of chemistry had to contend.

Electric Light.

In recent years most important investigations have been made by Prof. Graham Bell and Mr. Edison, which have led to the construction of the telephone, microphone, and other instruments for conveying the human voice and other sounds to great distances, and which may hereafter prove of the greatest importance. Although these inventions are still in their infancy, and may require time before they come to much practical utility, they in the meantime mark a great advance in electrical knowledge. The further discoveries of Gramme in France, and Siemens in England, of means for the easy and continuous production (or, as we might say, the manufacture) of electricity, and its application to lighting and other purposes, have caused the electric light to occupy at the present time a very prominent position among the subjects of interest to scientific men; and should the very recent alleged discoveries of Mr. Edison prove correct, by which the supply of electricity can be split up into a thousand or ten thousand different lights, and in this way be conveyed to our dwellings to take the place of gas, it may create a change the end of which we can hardly contemplate. For, in addition to the proposed extinction of gas, electricity so easily and successfully produced by the Gramme or Siemens machine may come to be applied in the arts and manufactures in various ways hitherto not known. It may in many cases supersede coal as a motive power, or be applied in metallurgy, and thus affect large commercial interests. It must, however, be borne in mind that up to the present time it has not been possible to give any reliable information as to the cost of supplying electricity on the large scale from a dynamo-electric machine, keeping up a continuous daily and nightly supply, whereas it is well known that gas can be supplied in this country at a very low price, owing to the fact of the by-products—consisting of tar, coke, and ammoniacal salts—finding a ready market at prices which, as a rule, may be said to nearly recoup the first cost of the coals used. In the meantime, while waiting for further information, these discoveries are well worthy of our thoughtful attention, and I trust that some of our members may favour the Society with papers on these subjects.

Noxious Gases.

The Acts of Parliament in reference to noxious gases and smoke have already proved beneficial to both manufacturers themselves and to the general public, and have become a recognised part of social legislation.

The recent report of the Royal Commission recommends that the escape from sulphuric acid works shall not exceed one grain of sulphur or half a grain of nitrogen per cubic foot of gas at 60° F.; and that in case of hydrochloric acid gas the escape shall not exceed 0·2 grain per cubic foot as heretofore, and that the inspection shall be ex-

tended to include manure works, copper works, coke ovens, and other industries not hitherto included under any Act. The deposits of soda waste, which in some localities have become a nuisance, especially old heaps, are also to come under the proposed new Act.

For information in reference to the escaping gases of chemical works, and the means for their prevention and examination, we are greatly indebted to Dr. Angus Smith, who has for many years conducted important experiments on the impurities in the air, especially in reference to hydrochloric acid, sulphurous acid, and ammonia, in the neighbourhood of large towns. The large amount of sulphurous acid in the atmosphere from the ordinary combustion of coal has received much attention of late years, and the recent paper by Mr. J. Pattinson on the impurities in small coals will further elucidate the question. I have myself at various times examined the air for sulphurous acid, and found it to exist at considerably further distances from large towns than might have been expected. At 5 miles it can be distinctly traced, and with certain winds it is found in the country even 10 miles from the Tyne. Some of these experiments, however, from local causes, require correction; but after making all allowances for small errors, it is now admitted that sulphurous acid from coal is in far greater quantity in the air than either hydrochloric acid or sulphuric acid passing off from alkali works, and that it must necessarily affect to a serious extent the growth of all vegetation within its reach. Mr. J. Mactear has stated that in well-constructed furnaces, where there is consequently no leakage of air into the flues, there is nearly 400 cubic feet of air passing for 1 lb. coal consumed; and taking an average of 1·5 per cent of sulphur in the coal, there is, therefore, equal to 0·655 grain of sulphuric acid per cubic foot of escaping gases, as compared to 0·2 grain of hydrochloric acid from condensers. He takes the coal consumed annually in Great Britain at 114,043,940 tons, and which at 1 per cent sulphur will give 3,500,000 tons of oil of vitriol escaping into the atmosphere, as compared to 44,716 tons from sulphuric acid works. It must, however, be admitted that it is difficult to lay down exact data from the percentage of sulphur in coal, for the estimation of sulphurous acid generated in combustion, owing to some kinds of coal containing more lime than others, which necessarily retains part of the sulphur in the ash. The only reliable or satisfactory plan would appear to be the testing of the atmosphere in different localities.

(To be continued.)

NOTICES OF BOOKS.

Sanitary Examinations of Water, Air, and Food: a Handook for the Medical Officer of Health. By Cornelius B. Fox, M.D., &c. London: J. and A. Churchill.

Great as has been the attention paid to the sanitary applications of chemistry, it must not be supposed that the last useful word has already been said. New methods have been devised for the analysis of sundry articles of food, of air, and especially of water, but it is still doubtful whether any of these is so satisfactory as to be incapable of improvement. Dr. Fox undertakes not so much to point out any novel process as to show how existing analytical methods may be made to throw the fullest light upon the wholesomeness or unwholesomeness of a water. His object has been "to avoid a consideration of these three subjects (water, air, and food), solely after the manner of an analyst, who mechanically deals with chemical operations and arithmetical calculations, but to treat them as a physician who studies them in connection with health and disease." This is the common sense view of the matter; what the medical practitioner, and, indeed, the intelligent man of the world require to know, is not so much what quantity of "albuminoid ammonia" or "organic nitrogen" is contained in a million parts, but rather whether it can be consumed with safety? This question the author undertakes to answer, and we are bound to say his endeavours are far from unsuccessful. He gives a full and critical account of the various processes for the determination of the amount and nature of the organic matter in water. He shows, from actual experience, that permanganate of potash sometimes fails to afford any indication of the presence of organic matter in water that contains a large quantity of it. The water of a well which received the drainage of a cesspool, which was occasioning enteric fever, and which contained 1·08 milligrms. of albuminoid ammonia per litre, still occasioned no discolouration with Condy's fluid. The author, however, considers that the indications of the permanganate process, when controlled by other evidence, "exhibit a remarkable agreement with the Frankland and Armstrong process, and with the Wanklyn, Chapman, and Smith process, when the latter is associated with a determination of the nitrates and nitrites." Concerning the latter analytical method, he makes the following very judicious remarks:—"If you rely solely on the indications of this process, you will sometimes come to a correct conclusion as to the quality of a water, but very often a mistake will be made. Couple the evidence afforded by it with other evidence of a chemical and microscopical character, and an error will never be committed. I regard this process as a most valuable aid to the formation of an opinion by the medical officer of health as to the nature of a water, as indispensable, indeed, as is auscultation to the physician in the diagnosis of lung and heart diseases." He rebuts the objections urged by Mr. Wigner, Dr. Hill, and others, against the Wanklyn process. Still it will be already apparent that he is no undiscriminating follower of Mr. Wanklyn, from whom, indeed, he differs in laying considerable weight upon the determination of the nitrates and nitrites, in insisting upon a microscopic examination of waters and their sediments, and in the greater importance which he seems to attach to the determination of phosphoric acid. On the other hand, he remarks that "the certificate of an analysis, made by Dr. Frankland's elaborate process, is about as incomprehensible as the process itself to all who are not chemical experts. Members of Sanitary Authorities and their medical officers often find these certificates perfectly unintelligible." It is interesting to find that the discrepancies between the Frankland and the Wanklyn processes, when fairly considered, are much less important than has been supposed. Dr. Fox has obtained upwards of 90 analyses of waters, executed at or near the same time by both processes, and, on careful comparison, he finds that in only one instance is there "a distinct conflict of opinion, and in this exceptional instance the divergence in the results is easily explained." When the results of analysis made by the two processes at or about the same time do not at all agree, the author traces the discrepancy to the neglect on the part of chemists employing the Wanklyn process to estimate the nitrates and nitrites, and to take the evidence thus afforded into due consideration. If the oxides of nitrogen are estimated, a really bad water is not likely to pass undetected by either process. In his appended table of the results of ten samples examined by both processes we find a very close coincidence between the opinions formed. It would have much facilitated comparison if all the results had been calculated to the same standard. Dr. Frankland expresses all the impurities of a water as parts per 100,000. Mr. Wanklyn, and many other chemists, give the organic impurities in milligrms. per litre (parts per million), but the nitrogen present in nitrate and the chlorine as grains per gallon. We have known municipal and sanitary authorities puzzled by these varying standards, and led to believe a discrepancy where none existed,—to the discredit of chemists and of chemistry in general.

Dr. Fox makes no mention of the tannic acid process for the qualitative examination of waters — a very pardonable omission, as its results are not sufficiently characteristic. Nor does he appear to have tried the "hydrosulphite" process of Girardin. We think also that, for the benefit of medical officers of health, he might have advantageously drawn attention to the light thrown upon the character of streams by the nature of the animal and vegetable organisms by which they are peopled. In this direction there is still much to be done. We read, *e.g.*, that water-cress is a test of the purity of water, growing only in unpolluted streams. Yet in a recent series of experiments we have found it to flourish exactly in proportion to the contamination of the water, thriving best in undiluted sewage!

The chapter headed "Mistakes of Water-Analysts, and How to Avoid Them" should be taken to heart by all sanitary chemists. It is unpleasant to think how much the reputation of a professional man is at the mercy of persons who may carelessly or maliciously send him a sample of water in a dirty bottle.

Space will not allow us to enter into a survey of the remaining sections of the work,—those devoted to the sanitary examination of air and of food. Under the latter head are comprised, not merely a notice of the ordinary adulterations of food and of their detection, but valuable instructions for the examination of questionable butcher's meat, poultry, fish, vegetables, &c.

The main characteristic of this book is sound, practical common sense. The author has succeeded in his attempt to free sanitary chemistry from "cloudy and chaotic surroundings," and has thus conferred a boon, not merely upon officers of health, but upon the medical profession at large, and upon the general public. Had the works of sanitary reformers been always as free from extravagances and crotchets, the day of pure water, pure air, and sound food would be much nearer.

CORRESPONDENCE.

"INSOLUBLE SILICIOUS RESIDUE."

To the Editor of the Chemical News.

Sir,—In a great many analyses of ores and technical products, the term "insoluble silicious residue" is used in the statement of results, to designate the portion of the substance which is left undissolved by the action of hydrochloric acid. This is certainly an improvement upon the custom of calling the insoluble residue "silica," as we have neither analysed nor heard of ores (excepting, perhaps, the new Caledonia nickel ores) of which cargo samples gave an insoluble residue of pure silica. We know of cases in which large percentages of baryta sulphate have borne the empirical formula SiO_2, in samples in which a trace of sulphur was pronounced to be present, and such things will happen so long as the commercial assays are made under the present strictures regarding time.

Now, unless some agreement is arrived at among chemists, as to how the insoluble silicious residue shall be obtained, it is still open so grave objection as an item in an analysis certificate, because it brings chemistry into disrepute, or (what is more unfortunate for the individual operator) throws the blame of incompetence upon some unoffending analyst. It is well known that iron and manganiferous iron ores occur associated with silicates soluble in hydrochloric acid, such as olivine and ilvaite among the peridotes, some pyroxenes and amphiboles, the zeolites, &c. Now, iron and manganiferous iron ores nearly always give more lime and magnesia to hydrochloric acid than is sufficient to combine with the carbonic acid found, and ores entirely free from carbonic acid usually yield at least one or two per cent of these bases to that solvent. These are the alkaline earths of the soluble silicates above metioned, and the silica combined with those bases is not included in the "insoluble silicious residue" of those analysts that filter off their hydrochloric acid solution without evaporating it to dryness.

We are aware that occasionally they recover this soluble silica from the precipitated oxide of iron afterwards, but this oxide of iron has been precipitated two or three times, and has taken up some silica from the glass vessel in which the precipitations are made. When the solution of the ore in hydrochloric acid is boiled, some silica is precipitated, the amount which remains in solution depending upon the amount of acid present, state of dilution, time of boiling, and rapidity of evaporation. Those that filter off and weigh the residue here obtained find results varying from 0·5 to 2 per cent below results found by evaporating the solution to dryness, which latter do not exhibit variance from each other.

While "insoluble silicious residue" is understood by most chemists to be the least suggestive item in an analysis, it is frequently a guaranteed percentage in ore contracts, as if it were a definite body like oxide of iron or magnesia. While any chemist can make a figure "high" or "low" at pleasure, we think that there is some cause for complaint amongst ore merchants, although it may sometimes fall upon the heads of those who stick to one method. On our part we prefer the "high" process, and shall continue to do so until we see a reason to adopt the other, and this because it gives the same results in duplicate assays, and includes the whole and not a fraction of the silica present. Perhaps some day the Institute of Chemistry may make regulations in such cases which no individual voice will effect.—I am, &c.,

A. E. A.

AMMONIACAL MANUFACTURE OF SODA.

To the Editor of the Chemical News.

Sir,—In your notice this week of "The Metallurgica Uses of Tungsten," it is stated that it exists in abundance in Cornwall. There is a general impression that such is the case, but the recurrence of much disappointment may be prevented by the statement that the ores of tungsten are by no means abundant. I am well acquainted with the principal sources of supply, and have found it difficult, if not impossible, to secure for any length of time even as small a qnantity as twenty tons per month.

I have been much interested in the details of "The Ammoniacal Manufacture of Soda," but they are of little or no service from the expression "1 ton of ⅔ per cent of soda or 1½ tons of pure bicarbonate of soda." Does "or" mean equivalent to? If so, taking the ton at 95 per cent, should not the equivalent be 46 cwt. of pure bicarbonate of soda? Information on this point may enable an estimate to be made of the cost of manufacture, especially if to the particulars of expenditure of materials this cost of labour be considered.

I trouble you with this, as an explanation may be of service to others as well as to myself.—I am, &c.,

Robert Oxland, F.C.S.,
Public Analyst for Devonport.

October 26, 1878.

The Faraday Lecture.—We would remind the Fellows of the Chemical Society that the Faraday Lecture will be delivered on Tuesday, November 12, in the theatre of the Royal Institution, by Prof. Ad. Wurtz. On the day following the lecture the Fellows of the Society will entertain Prof. Wurtz at a Dinner at Willis's Rooms. The Dinner tickets are one guinea each.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 16, October 14, 1878.

Action of the Juice of Beet-Leaves upon Ferric Chloride under the Influence of Light.—H. Pellet.—The juice of these leaves, in the absence of chlorophyll, has the power of easily reducing salts of iron under the influence of light. This reduction may be effected in the dry state, or with solutions having no longer any vitality. This reductive action is due to the oxidation of one or of more of the organic substances contained in the leaves, such as the sugars, tannin, nitrogenised matters, &c.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin. No. 10, 1878.

On Diphenylen-keton from Anthraquinon, and on Pyro-condensation.—R. Anschütz.—If anthraquinon is heated, mixed with 20 parts of quick-lime, the main product is diphenylen-keton, along with smaller quantities of diphenyl, anthracen, and fluoren. The author proposes the following law of pyro-condensation:—"Pyro-condensations of phenyl-phenyl derivatives to phenylen-phenylen derivatives take place always in such a manner that the atoms or groups which link the phenylen-residues together take up the diortho position with reference to such residues."

Detection of Small Quantities of Fluoren along with Phenanthren or Anthracen.—R. Anschütz.—Fifteen grms. of the mixture to be tested for fluoren are oxidised with potassium bichromate and sulphuric acid, Fittig and Ostermeyer's principle. After boiling for six hours with a cohobator the filtered product is distilled with watery vapour, and the distillate is slowly crystallised from alcohol. If fluoren was present, compact crystals of diphenylen-keton separate out.

On Monobrom-phenanthren and Phenanthren-bibromide.—R. Anschütz.—This paper deals chiefly with hypothetical considerations.

Preliminary Notice on an attempt to prepare Phenyl-glyceric Acid.—R. Anschütz and L. Kinnicutt.—The authors take as their point of departure dibromo-cinnamic acid and its ether. They have also examined cinnamic-methyl, ethyl, and propyl ethers, and certain brom-addition products of the methyl and ethyl ethers.

Addition of Bromic Hydride by means of its Solution in Glacial Acetic Acid.—R. Anschütz and L. Kinnikutt.—The authors combine cinnamic acid with bromic hydride by means of the above solution.

Decomposition of Wood Tar at a Red-heat.—A. Atterberg.—The author mentions that the results obtained by Liebermann, Burg, Salzmann, and Wichelhaus agree with his own observations on the tar of pine-wood. By passing the tar and the less volatile tar-oil of the Swedish "wood-oil" works through iron tubes filled with coke at bright redness, he obtained a tar containing all the important constituents of coal tar. It yielded 7 per cent benzol and toluol; it was rich in naphthalin; it contained a tolerable quantity of anthracen, but little phenol. At incipient redness were obtained 10 per cent toluol, containing a little benzol; phenols boiling between 190° and 220°, but little phenylic acid, 0·3 per cent of anthracen, but no naphthalin.

Naphthalin Chlorides.—A. Atterberg.—The author is dubious about the existence of the β-naphthalin tetrachloride of E. Fischer.

On Fluoranthren.—A. Atterberg.—A tabulation of a series of aromatic hydrocarbons.

New Formation of Nitro-ethan.—P. Lauterbach.—If equivalent quantities of potassic sulph-ethylate and sodium nitrite are submitted to dry distillation, an oily matter, from which pure nitro-ethan is easily obtained by fractionated distillation.

On a Dichlor-salicylic Acid and certain Derivatives of the Monochlor-salicylic Acid melting at 172°.—E. J. Smith.—The author describes certain salts of the first-mentioned acid discovered by Rogers (1875), and a different acid which he obtained, and which melts at 214°. The monochloric acid and its salts and derivatives are also described.

Synthesis of Isatin and Indigo-Blue.—A. Baeyer.—If amido-oxindol (obtained from nitroso-oxindol) is oxidised with ferric or cupric chloride, or nitrous acid, isatin is readily obtained. The conversion of isatin into indigo-blue had been previously effected by the author and Emmerling. Indigo-blue can likewise be obtained from hydrindic acid and amido-oxindol, with the aid of phosphor-oxychloride and phosphor-pentachloride.

Preliminary Communication.—Th. Diehl and V. Merz.—If amido-diimido-resorcin is heated to about 170° with dilute hydrochloric acid, there is formed along with sal-ammoniac a crystalline body of great tinctorial power, and having the composition of trioxyquinon, $C_6H_4O_5$.

Nitrous Gases obtained from Nitric Acid and Starch, and those of the Vitriol Chambers.—G. Lunge.—In opposition to O. N. Witt (*Berichte*, xi., 756) the author maintains that the nitrous fumes obtained by the action of nitric acid upon starch, &c., consist not of N_2O_4, but of N_2O_3. In the lead chambers, when in normal action, little but N_2O_3 is present, and no N_2O_4.

Leucin from the Sprouts of Pumpkins.—E. Schulze and J. Barbieri.—The authors have demonstrated the presence of this compound and of tyrosin in the sprouts of pumpkins.

Formation of Sulphates during the Decomposition of Albumen in Getminating Plants.—E. Schulze.—The sulphuric acid is formed from and in proportion to the sulphur of the decomposed albumen.

Formation of Colouring-Matters by the Action of Benzo-trichloride upon Phenols and Tertiary Aromatic Bases.—Oscar Dœbner.—Among the colouring-matters of this group the author has specially examined the one produced by the reaction of dimethyl-anilin and benzo-trichloride, and known in commerce as "malachite green." The most suitable proportions for its preparation are as follows:—To 2 mols. dimethyl-anilin, mixed with about half its weight of chloride of zinc, is gradually added, at a gentle heat, 1 mol. benzo-trichloride. After completion of the reaction the deep green mass is freed from extraneous products by the action of steam. The colouring-matter thus obtained, a zinc double salt of the coloured base, is soluble in water—especially hot—and more readily in alcohol, with a deep green colour, and possesses all the attributes of a good dye. The base may be isolated by treatment with soda-lye and agitation with ether, on the evaporation of which it remains as a red-brown oil, which on drying up shows no tendency to crystallise.

Les Mondes, Revue Hebdomadaire des Sciences. No. 1, September, 1878.

Perishable Character of Paper.—Prof. Renleaux calls attention to the nature of the paper used in the Administrative Departments. It is composed almost entirely of wood, and documents written upon it will be lost in ten to fifteen years.

The Manures of M. G. Ville, at the Exhibition.—M. Moigno writes—"Every year on the High Alps enormous quantities of nitrogen are collected in the shape of

cheese, and no manure is ever applied; even the excreta of the cows are kept off. Whence comes this nitrogen if not from the atmosphere, and how is it rendered assimilable if not by the electric effluve?"

Reimann's Färber Zeitung,
No. 38, 1878.

Methylen Blue.—The Baden Aniline and Soda Company, of Mannheim, have patented a process for the preparation of blue colouring matters from dimethyl-anilin and other tertiary aromatic monamins. C. Lauth obtained violet dyes from para-phenylen-diamin, which, on the introduction of methyl, &c., yield blue and green compounds. The difficult preparation of phenylen-diamin prevented the practical utilisation of Lauth's process. The Baden Aniline Company propose instead to use dimethyl-anilin. By the action of the hydrochlorate with the nitrite of soda nitroso-dimethyl-anilin is prepared and reduced to amido-dimethyl-anilin by means of sulphuretted hydrogen. The solution is oxidised with ferric chloride. Or amido-dimethyl-anilin may be oxidised and the blue colouring matter produced by sulphuretted hydrogen. The mixture is saturated with common salt, precipitated with chloride of zinc, and filtered. On treating the precipitate with water the soluble colouring matter is extracted, the solution saturated again with salt and re-precipitated with zinc, the precipitate filtered, pressed, and dried, when it is ready for use.

Patent Congress.—The International Congress on Patent-right, sitting at Paris, discussed the respective advantages of a preliminary examination (German and American system), and of patents granted as a matter of course unless opposed by some party interested (French, Belgian, Austrian, &c., system). To Prof. Reuleux, who advocated the previous examination, it was replied that the German patent office might some day fall into the hands of officials like those who managed the old Prussian patent office, and who rejected almost every application. The exclusion of chemicals from the German patent system was also discussed. Switzerland was justly stigmatised as the paradise of pirates. From the various reports of this congress it appears that England has not been there represented, or if any English delegates were present they took no prominent part in the proceedings.

Chemiker Zeitung.
No. 40, October 3, 1878.

Volumetric Determination of Potassium.—Carnot proposed to precipitate potassa as a double hyposulphite of potassium and bismuth. This process has been made capable of more general application by dissolving the double salt in water and determining the hyposulphurous acid by means of a standard solution of iodine.

New Process for the Manufacture of Caustic Soda.—Bazin first converts the sulphate into sulphide by ignition with wood-charcoal, dissolves this in boiling water, and treats the boiling solution with cupric or ferric oxide. The metal combines with sulphur and remains undissolved, whilst the sodium takes in exchange oxygen, and becomes converted into a strong solution of caustic soda. Whether the reaction of the metallic oxide and the alkaline sulphide is complete is scarcely certain.

Bulletin de la Societe Chimique de Paris,
Tome 30, Nos. 6 and 7, Oct. 5, 1878.

This issue is entirely made up of articles taken from *Liebig's Annalen*, the *Berichte Deutsch. Chem. Gesellschaft*, and the CHEMICAL NEWS.

NOTES AND QUERIES.

Testing and Valuation of Gas Liquors.—The valuable paper by Mr. T. H. Davis in the CHEMICAL NEWS, vol. xxxviii., p. 193, would be complete if he explains what is meant by "normal sulphuric acid" and "normal soda."—SUL. AMM.

MEETINGS FOR THE WEEK.

THURSDAY, Nov. 7th.—Chemical, 8. "On the Red Colouring Matter of the *Lithosperium Erythrorhizon*," by M. Kubara. "On the Occurrence of Certain Nitrogen Acids amongst the Products of Combustion of Coal-gas and Hydrogen Flames," by L. T. Wright. "Second Report on Researches on some Points in Chemical Dynamics," by C. R. A. Wright, D.Sc., and A. P. Luff. "On the Constitution of the Olefine Produced by the Action of Zinc on Ethylic Iodide," by Dr. E. Frankland, F.R.S.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

SEPTEMBER, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Clear	0·000	0·011	0·105	0·089	19·80	8·010	0·468	1·08	1·430	13·7	3·30
West Middlesex	Clear	0·000	0·010	0·105	0·089	19·00	8·400	0·504	1·01	1·300	13·7	3·00
Southwark and Vauxhall	Clear	0·000	0·011	0·105	0·103	18·40	7·530	0·612	0·94	1·300	13·7	3·30
Chelsea	Clear	0·000	0·009	0·129	0·042	16·80	7·840	0·504	1·01	1·200	13·2	3·00
Lambeth	Slightly turbid	0·000	0·010	0·126	0·096	20·80	8·840	0·612	1·08	1·440	14·3	3·70
Other Companies.												
Kent	Clear	0·000	0·001	0·435	0·001	29·90	11·640	1·081	1·74	4·000	20·6	6·50
New River	Clear	0·000	0·007	0·150	0·057	19·30	8·730	0·648	1·01	1·000	14·3	3·30
East London	Clear	0·000	0·007	0·075	0·053	17·90	7·630	0·684	1·16	1·730	13·2	3·30

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B.

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c

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CONTENTS.

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II. The Progress of the Doctrine of Development.
III. The "Woman's Rights' Question considered from a Biological Point of View.
IV. What is a Flower? By F. T. Mott, F.R.G.S.
V. Genesis of Matter.
VI. The British Association for the Advancement of Science.
Index and Title Page to Vol. VIII.
Notices of Scientific Works, Scientific Notes, &c.

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ORGANIC MATERIA MEDICA.
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Widnes, October, 1878.

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GEOLOGY.—In the Preface to the Student's ELEMENTS OF GEOLOGY, by Sir Charles Lyell, price 9s., he says:—"As it is impossible to enable the reader to recognise rocks and minerals at sight by aid of verbal descriptions or figures, he will do well to obtain a well-arranged collection of specimens, such as may be procured from Mr. TENNANT (149, Strand), Teacher of Mineralogy at King's College, London." These Collections are supplied on the following terms, in plain Mahogany Cabinets:—

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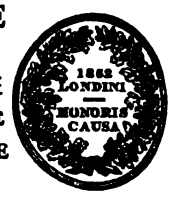

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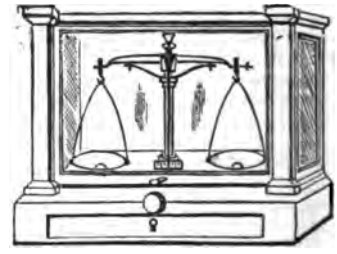

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 989.

ON DECIPIUM: A NEW METAL FROM SAMARSKITE.

By M. DELAFONTAINE.

WHILST prosecuting my researches on the samarskite earths of North Carolina I discovered in them a new metal which I have called Decipium (from *Decipiens*). This metal, which possesses the properties common to those of cerite and gadolinite, forms an oxide, the equivalent of which is approximately 122, its formula being DpO (or $Dp_2O_3=366$).

I have not yet effected the separation of this new metal from didymia completely enough to affirm that its colour is white. Its salts are colourless; the acetate crystallises very easily, and seems to be less soluble than that of didymium, but more so than that of terbium. The decipio-potassic sulphate is only slightly soluble in a saturated solution of potassic sulphate, but dissolves easily in water.

The nitrate of decipium gives an absorption-spectrum composed of three bands at least, in the indigo and blue. In order to see them well the aid of sunlight is necessary, the best way being to direct the slit of the spectroscope towards the disc of the sun, interposing a piece of blue glass before the eyepiece. The most refrangible ray is a little narrower than that of philippium and the *n* of didymium. It is rather dark; its middle closely corresponds to the wave-length 416, or to 195 of M. Lecoq's scale. It is nearly in the middle of the space between Fraünhofer's lines G and H, but more nearly approaches G. Neither didymium nor terbium give any ray in this region. The band which characterises terbium is hardly so broad; it is seen more to the right, and is so near to the limit of the spectrum which I obtain with my instrument that an intense solar light is necessary in order to clearly distinguish it. In exceptional conditions of light I have been able to observe the violet space beyond, and to recognise in it two well defined rays, which are probably H and H'.

The second band of decipium is narrower, more intense, and a little indistinct at the edges. It is seen in the less refrangible blue; its middle corresponds very nearly to the wave-length 478. It is nearly in the same place as a band of didymium, but its intensity is incomparably greater. More to the left, and nearer to the limit of the blue and green, there is a rather indistinct minimum of transmission, which may be the result of the overlapping of the two faintly-defined bands. I have not, however, succeeded in separating them. I intend to return to the subject shortly.

In the present state of my knowledge I recognise in the samarskite earths of North Carolina (more or less combined with other earths) the following:—

Name.	Colour.	Equivalent.	Characteristic Absorption-Band.
Yttria	White	YO =74·5 (Delafontaine)	None
Erbia	Rose	ErO=130 (Bunsen, Clève)	520 to 522
Terbia	Orange	TbO=114-115 (Delafont., Marignac)	About 400
Philippia	Yellow	PpO= about 90 (Delafont.)	,, 449
Decipia..	White?	DpO=about 122 (,,)	416
Thoria	White	ThO_2=267·5 (,,)	None
Oxide of didymium	Brownish	DiO=112-114 (Marignac, Clève)	572 to 577
,, of cerium..	Pale yellow		None

The equivalents* of the metals contained in some of these earths show rather interesting numerical relations to each other:—

Yttrium	58
Philippium	74 or 58+2×8
Terbium	98 or 58+5×8
Decipium	106? or 58+6×8
Erbium	114 or 58+7×8

If the above metals are considered as triatomic, the difference will be 12, or one of its multiples, instead of 8.—*Comptes Rendus.*

* This term is employed until the true atomic weights have been accurately determined.

FURTHER OBSERVATIONS ON THE CHEMICAL AND MECHANICAL TESTS OF CAST-STEELS.

By SERGIUS KERN, M.E., St. Petersburg.

THE author has already remarked in the CHEMICAL NEWS that in many cases a chemical analysis of steel does not show the quality of it as a material for manufacturing purposes. Every steel ingot, after rolling or hammering, must be tested mechanically before being used or brought into the market, for if chemical analyses only are considered very grave misapprehensions may happen. The following Table I. shows the results of testing certain samples of rolled steel plates. Table II. contains the results of the chemical analysis of the same plates. Every analysis represents the average composition, as from every sample of the plate shearings from different parts were collected. The samples which were cut off from the plates for testing them mechanically were not annealed:—

TABLE I.

No. of Specimen.	Breaking Weight; Tons per Square Inch.	Elongation Per Cent.
1	30·83	12·87
2	33·33	14·50
3	31·02	15·87
4	32·52	18·12
5	27·79	13·12
6	31·11	18·75
7	29·33	14·50
8	32·70	16·37
9	33·10	12·00
10	31·02	15·37

All these plates being prepared of mild steel they cannot be called good samples, as these plates were required to have not less than 20 per cent of elongation. The steel as shown in Table II. was of a very good quality, but the working of it was rather inferior, and the steel before rolling required hammering:—

TABLE II.

No. of Specimen.	Carbon. p.c.	Sulphur. p.c.	Phosphorus. p.c.	Silicon. p.c.
1	0·27	0·01	0·03	traces
2	0·23	0·03	0·03	—
3	0·25	0·02	0·04	0·01
4	0·24	0·01	0·02	0·02
5	0·24	0·02	0·03	0·02
6	0·23	0·02	0·05	0·01
7	0·28	0·04	0·02	traces
8	0·25	0·03	0·03	0·01
9	0·24	0·03	0·04	0·01
10	0·23	0·01	0·02	0·03

Copper was absent in all the samples. The amount of manganese was 0·10 to 0·15 per cent. Pig-irons of the best qualities were used for the preparation of the steels.

These two tables require no comment, but they may show that at present it would be rather better for buyers first to obtain information on the mechanical qualities of

steels, viz., the breaking weight and the percentage of elongation. Bad materials cannot yield a fair product, but good raw steel, if carelessly worked, may easily give a bad product, the quality of which may be seen at a glance, not by chemical analysis but by the mechanical tests.

M. Grüner, at the meeting of the Société Minérale, at St. Etienne (October 6, 1877), proposed a very good, practical, and simple method, which consists in stamping on every steel plate or forged ingot the resistance (breaking load in kilogrms. per square millimetre) and the percentage of elongation. It must be remarked that several English firms have for some time past been using such a system, which certainly deserves more general employment.

OZONE AND THE ATMOSPHERE.*

By ALBERT R. LEEDS Ph.D.

In a paper entitled "Recent Progress in Sanitary Science,"† I endeavoured to give a short *resumé* of the labours of European physicists upon the estimation of atmospheric oxygen and ozone. I had been unable to find a published analysis of the atmosphere at any locality in the United States, all our knowledge upon the composition of the atmosphere being derived from foreign sources. Moreover, few systematic observations upon ozone had been prosecuted, or, if carried on, had rarely been published.

In making the oxygen estimations, Bunsen's methods were in most respects implicitly followed. The eudiometers employed were graduated by ourselves with great care. A gas-room was fitted up, in which the thermometric readings rarely varied more than one-half a degree during the periods of observation. The flasks employed to collect samples were of thin glass, 2½ c.m. in diameter, 20 c.m. long, drawn out at one end into a tube about 15 c.m. in length. After cleansing and drying, a pellet of pure potassic hydrate was introduced, and the tube sealed at a point about one-third from its extremity. When a sample was taken, the end of this tube was broken off with the aid of a file, the diameter of the tube near the flask narrowed down by heating in a lamp, the air in the interior completely changed by aspiration through a fine tube introduced until it nearly reached the bottom of the flask, which was then sealed with the flame. During the summer of 1876, numerous specimens of air were collected at Hoboken and vicinity, at the Centennial Exhibition, Philadelphia, and upon various mountain tops and in many valleys of the Adirondacks, New York State. The temperature, barometer, wind, &c., were noted at the same time, although these meteorological data are not of much importance, except as part of a connected and simultaneous series of observations, conducted with a view of establishing a chemical climatology of the United States. At present, what is done in this direction can be looked upon merely as the beginning of a study which will hereafter yield results of value to the agriculturist, the medical practitioner, and the physicist. Suitable equipment of our observatories, so that they may yield not merely the meteorological, but also the requisite chemical data, is essential to advance in climatology. The table in next column contains some of the most interesting of the determinations heretofore made.

Atmospheric Ozone.

In order to obtain some knowledge of the character of the results arrived at in testing for atmospheric ozone according to customary methods, I prepared a number of ozoscopic papers, with pure materials, after the formula of Osann, and during the summers of the years 1876 and 1877, in the Adirondacks, and during the rest of this period, in Hoboken, made regular observations. At Hoboken the results were negative, an ozone reaction being obtained on rare occasions only, and then in the most feeble and undecided manner. On the contrary, in Keene Flats, N.Y., the days were few in which the ozonoscopes were unaltered; usually they were decidedly affected, and sometimes to a degree most striking. The point in the Keene Flats, where the observations were conducted, was about 700 feet above sea-level, the surrounding vegetation mostly deciduous, the population and dwellings, though scanty, not inconsiderable. Even more interesting were the results during the following summer, 1877, at a point near the upper end of Upper Saranac Lake. This was located at a much higher altitude than the foregoing, entirely isolated by miles of primitive forest from any other dwellings. The woods abounded in hemlocks, pines, larches, spruces, and were often redolent with odours of the balsam. Owing to a supposed virtue in these resinous-smelling woods, large numbers of patients, especially those suffering from pulmonary diseases, are sent by the physicians of New York and other large cities to this portion of the Adirondacks. Bearing in mind that the beneficial effects are supposed to be due entirely to the atmosphere—not to any mineral waters, or peculiarities of regimen, exercise, or occupation—one of these sanitariums, like that on St. Regis Lake, would afford an opportunity of testing some disputed points concerning the effects of a varying constitution of the atmosphere on different diseases.

Certainly the intelligent selection of an appropriate sanitarium is a duty frequently devolving upon the physician, but one which at the present time he can in many cases only imperfectly perform from the lack of positive knowledge. Vague impressions or reports can never take the place of atmospheric analysis; they bear a similar relation to it with that which the ancient foretelling of the weather does to the present signal service reports. It is to be hoped that the time is not far distant when the Government may think it important to do as much for public hygiene as for commerce and agriculture.

Although in the light of subsequent experiments little value, I think, can be attached to the following ozone observations, yet as illustrative of the variations in the amount of the so-called ozonic reaction, and of the apparent lack of connection between it and other meteorological phenomena, the accompanying table may be of interest:—

Table of the Percentage of Oxygen contained in the Atmosphere at Various Localities in the United States, 1876.

Locality.	Date.	Per cent.
Stevens Institute of Technology	July 4, 12 m.	20·957
Ditto ditto ditto	Aug. 2, 1.20 p.m.	20·957
Ditto ditto ditto	Aug. 11, 1 p.m.	20·821
Ditto ditto ditto	Aug. 11, (duplicate)	20·843
Ditto ditto ditto	Aug. 29	20·954
Ditto ditto ditto	Aug. 30, 9.30 a.m.	20·934
Ditto ditto ditto	Aug. 31, 5.20 p.m.	20·942
Ditto ditto ditto	Sept. 1, 10.30 a.m.	20·952
Ditto ditto ditto	Sept. 1, (duplicate)	20·957
Ditto ditto ditto	Sept. 7, 10 a.m.	20·932
Ditto ditto ditto	Sept. 7, (duplicate)	20·944
Horticultural Hall, Centennial..	Aug. 15, 3.40 p.m.	20·964
Machinery Hall, ditto ..	Aug. 21, 5.15 p.m.	20·937
Main Building, ditto ..	Aug. 18, 4 p.m.	20·868
Agricultural Hall, ditto..	Aug. 22, 3 p.m.	20·857
U.S. Building, ditto ..	Aug. 16, 4 p.m.	20·878
Centennial Grounds, do.	Aug. 15, 6 p.m.	20·962
Ditto ditto do.	Aug. 18, 6 p.m.	20·918
Stevens Institute of Technology	Sept. 26, 10 a.m.	20·915
Keene Flats, Adirondacks	July 17	21·029
Mt. Marcy, summit of ..	July 21, 3 p.m.	20·928
Ditto ditto ..	July 21, (duplicate)	20·926

* From proof sheets of the *Annals of the N.Y. Academy of Sciences*, furnished by the Author.

† *Annals of the Lyceum of Natural History, N.Y.*, vol. xi., November, 1876

Register of Ozone Observations made at Upper Saranac Lake, Northern New York; Altitude 1600 feet above the Sea. Times of Observation, 7 a.m. and 7 p.m. Season, Summer of 1877. Scale of 10.

Date.	Ozone.	Thermometer.	Barometer.	Weather. Wind.	Rain.	Clouds.	Remarks.
July 17	5	74°	27·900	S.	Heavy		Considerable lightning
„ 18	2	70	28·000	S.	—		
„ 19	2	71	27·675	N.E.—S.W.	Much		Great rain at night and lightning
„ 20	—	70	28·850	S.W.	—	Cirrus	Air very clear; rain at a distance
	2·5	73	27·900	S.W.	—	Cum. (1)	
„ 21	2	62	28·000	S.W.	—	Cum. (6)	
	1	64	28·150	S.W.	—	Cum. (1)	Very pleasant day
„ 22	0	67	28·275	S.W.	—	Cum. (1)	Great cumulous clouds
	0	72	53·275	S.W.	—	Cum. (1)	Little air, not bracing
„ 23	1	68	28·350	S.W.	—	Nimb. (7)	„ „ „
	0	72	20·275	S.W.	—	Cum. (3)	
„ 24	1	66	28·300	S.	—	Cirrus (5)	
	1	—	—	—	—	Cum. (1)	
„ 25	0	68	—	—	—	Cum. (1)	
	1	80	28·100	—	—	Cum. (2)	
„ 26	1	71	28·000	S.W.	—	Stratus (3)	
	3	—	28·925	S.W.	—	„ (1)	
„ 27	0	72	28·125	S.W.	—	„ (5)	Heavy rain at night, and lightning
	1	80	28·150	S.W.	Rain	Nimb. (10)	—in morning cool and refreshing
„ 28	5	72	28·100	S.W.	—	„ (10)	
	1	—	28·050	—	Rain	Nimb.	
„ 29	1	72	28·000	—	Rain	Cum. (2)	
	1	76	27·925	—	Rain	Nimb. (10)	
„ 30	3	—	—	N.	—	Cum	
	3	78	28·075	N.	—	Cum.	Very bright
„ 31	0	64	28·200	S.W.	—	Clear (0)	Exhilarating
	6	72	28·250	N.	—	Clear (0)	
Aug. 1	5	66	28·325	Calm	—	Clear (0)	No air stirring
	4	75	28·275	S.	—	Clear (0)	Exhilarating
„ 2	3	68	28·250	S.W,	—	Stratus (1)	
	4·5	72	28·100	S.	—	„ (3)	"Mackerel-sky."
„ 3	4·5	66	28·025	S.	—	„ (10)	
	2	72	27·925	S.W.	—	Cum. (1)	Clear and bright
„ 4	4	64	28·025	N.	—	Cum. (3)	Wind-storm at night
	2·3	66	28·000	N.	—	Cum. (5)	Wind-storm in afternoon
„ 5	2	62	27·950	S.	—	Cum. (1)	Opposing air-currents producing
	3	64	27·950	S.	—	Nimb. (10)	five storms.
„ 6	2	61	27·925	N.	—	Cum. (1)	Brilliant atmosphere
	1·2	66	27·900	N.	—	Stratus (9)	Bright
„ 7	7	63	27·800	S.	—	Nimb. (10)	Heavy rain at night
	6	72	27·800	S.	—	Stratus (7)	Shifting clouds
„ 8	7	70	27·825	Calm	—	Clear (0)	Heavy rain and thunder during
	7	70	27·825	N.E.	Much	Cum. (5)	day
„ 9	1	72	27·825	S.W.	—	Fog (10)	Haze (smoke)
	3	74	27·775	S.W.	—	Cum. (5)	Dull
„ 10	3	72	27·800	S.W.	Rain	Cum. (1)	Haze. Little air
	1·2	65	27·350	S.W.	—	Cum. (2)	
„ 11	1	65	27·975	S.W.	—	Stratus (10)	
	1	67	28·075	S.W.	—	Nimb. (4)	Thunderstorms.
„ 12	0	68	28·050	S.	—	Clear (0)	Starlight night
	2	65	27·950	S.W.	Much	Nimb. (10)	Opposing winds
„ 13	1	68	27·950	S.W.	Much	Nimb. (10)	
	2	70	28·000	N.E.	—	Nimb. (9)	
„ 14	1	—	27·925	Calm	—	Mist (5)	Heavy rain at night
	1	65	27·900	W.	Rain	Nimb. (10)	
„ 15	1	67	27·925	S.W.	Rain	Cum. (10)	
	—	67	27·900	N.E.	Rain	Nimb. (10)	
„ 16	5	64	27·875	Calm	Rain	Cum. (10)	
	1	66	27·850	N.E.	Rain	Nimb. (5)	

(To be continued.)

NOTES FROM THE PARIS EXHIBITION.

ENGLISH AWARDS IN THE SCIENCE SECTION.

GROUP II., CLASS 15.

Mathematical and Philosophical Instruments.

Gold Medals.—J. H. Dallmeyer; H. Grubb; A. Légé and Co.; Negretti and Zambra; T. Ross and Co.; Sir William Thomsor.

Silver Medals.—H. Crouch; Horne and Thornthwaite M. Pillischer; J. Swift; S. Tisley and Co.

Bronze Medals.—E. Cetti and Co.; Dollond and Co.

Honourable Mentions.—F. Darton and Co; A. E. Thomas.

GROUP V., CLASS 43.

Mining and Metallurgy.

Grand Prizes.—Sir J. Brown and Co.; C. Cammell and Co.; Johnson, Matthey, and Co.; Sir Joseph Whitworth and Co.

Diploma of Honour.—North of England Manufacturers' Association; Iron Masters' Association of Cleveland.

Gold Medals.—E. P. and M. Baldwin; W. Bartleet and Sons; Burys and Co.; Broughton Copper Co.; Brown, Bayley, and Dixon; Elkington and Co.; Earl Granville and Shelton Iron Co.; Hadfield Steel Foundry Co.; Harrison, Ainslie, and Co.; Hopkins Gilkes; W. Jessop and Sons; Landore-Siemens Steel Co.; Leeds Forge Co.; Lilleshall and Snedshill Iron Co.; Nettlefolds; Patent Plumbago Crucible Co.; G. H. Ramsay; Seebohm and Dieckstahl; Turton, Thomas, and Sons; West Cumberland Iron and Steel Co.; The Wigan Coal and Iron Co.

Silver Medals.—F. S. Barff; Barnard, Bishop, and Barnard; J. Bedford and Sons; F. Braby and Co.; J. B. Brown and Co.; Cambrian Patent Fuel Co.; G. Chambers and Co.; T. and C. Clark and Co.; Devon Great Consols Co.; Doulton and Co.; J. Dunnachie; A. Everitt and Son; W. D. Houghton; Jonas, Meyer, and Colver; A. Kenrich and Sons; Leach, Flower, and Co.; E. Morewood and Co.; R. S. Newall; E. Packard and Co.; Patent Nut and Bolt Co.; J. Russell and Co.; Ryhope Coal Co.; F. Smith and Co.; J. R. Spencer and Son; H. H. Vivian and Co.; H. Wiggin and Co.; P. Wright and Sons.

Bronze Medals.—J. H. Andrew and Co.; T. Bennett and Sons; Boulton and Paul; Colver Brothers; J. Corbett; Diamond Fuel Co.; T. Francis and Co.; Graigola Merthyr Co.; N. Greening and Co.; Hatton, Sons, and Co.; T. Higgin; Hill and Smith; T. Jowitt and Sons; Kirby, Beard, and Co.; London and South Wales Coal Co.; Marquis of Londonderry; H. Milward and Sons; J. Shaw; South Derwent Colliery Co.; J. R. Spencer and Son; Tayler and Co.; G. Thomas and Sons; R. W. Winfield and Co.; C. Wood.

Honourable Mention.—J. B. Addis and Sons; Ash and Lacy; Avery, William, and Son; Buckinsham Mining Co.; E. Burell; Burnhope Coal Co.; J. Cliff and Sons; Cooke Brothers; Cramlington Coal Co.: E. Evans; D. and H. C. Evans; Great Western Colliery Co.; E. J. Hattersley and Co.; Hayes, Crossley, and Co.; Macdonald, Field, and Co., E. Major and Co.; J. Marston; J. C. Montgomerie; Nicholson; Palmer, Morgan, and Co.; Phosphor Bronze Co.; Read, Jefferson; W. Smith and Sons; W. Spencer and Co.; Derwent Colliery Co.; Star Manufacturing Co.: Thriscutt and Bale; Tweddle, McLaren, and Co.; A. Tylor and Co.; Warrington Wire Rope Works; W. B. Wright and Co.

Group V., Class 47.

Chemical and Pharmaceutical Products.

(Additional names omitted from list published in the Chemical News, October 25.)

Grand Prizes.—Solway and Co.; Walter Weldon.

Gold Medal.—Mackintosh and Co.

Silver Medals.—Atkinson and Co.; G. Schweppe and Co.

Bronze Medals.—Bewley and Draper; J. Basisto; W. Corry and Co.; J. Green; H. and T. Kirby and Co.; G. Morse and Co.; Southall Brothers and Barclay; D. S. Sorer and Sons.

Group VI., Class 65.

Telegraphy.

Grand Prize.—A. G. Bell.

Gold Medals.—Siemens Brothers; M. Stroh; British Telegraph Manufactory; Telegraph Construction and Maintenance Co.

Silver Medal.—British Telegraph Manufactory.

Bronze Medals.—A. Jamieson; C. E. Zimdars.

Honourable Mentions.—Patent Nut and Bolt Co.; S. A. Varley.

Group II., Class 14.

Silver Medals.—G. Cheavin; J. Gray and Co.; T. Lemale and Co.; Mayer and Meltzer.

Bronze Medals.—Peyton and Peyton; J. H. Porter; F. C. Rein; J. Ward; R. R. Whitehead and Brothers.

Honourable Mentions.—T. Allen; T. Longdon and Co.; Mrs. Rein.

H. C.

MANUFACTURE OF RESORCIN, EOSIN, AND OTHER DERIVATIVES OF RESORCIN.

By MM. BINDSCHEDLER and BUSCH.

The authors give an account of the recent improvements in the manufacture of these colours.

1. *Resorcin.*—Into a cast-iron apparatus, fitted with an agitator and a leaden cohobator, are poured 90 kilos. of fuming sulphuric acid at 80° B., and 24 kilos. of pure benzol are allowed to flow in through the cohobator in a slender stream, stirring continually. The mass gradually becomes hot, the vapours being condensed in the cohobator falling back. In two or three hours the entire quantity of benzol will have become converted into sulphobenzolic acid. After having removed the cohobator and connected the cover of the apparatus with a distillation-worm, the contents are gradually heated again, raising the temperature to 275°, when the sulpho-benzolic acid is converted into disulpho-benzolic, and along with water there distils a little benzol which has escaped the reaction. At this temperature the whole is maintained for about twenty minutes. It is then allowed to cool, and thrown into about 2000 litres of cold water. It is heated to boiling, and exactly neutralised with milk of lime. The whole of the matter is then passed through a filter-press which retains the sulphate of lime. The colourless effluent contains all the disulpho-benzolic acid as a salt of lime. This is then transformed into a soda-salt by adding the equivalent quantity of carbonate of soda. The resulting mass is again passed through a filter-press which retains carbonate of lime, whilst the effluent liquid is evaporated to perfect dryness. Of this product 60 kilos. are placed in a cast-iron boiler in which 150 kilos. of caustic soda, at 76°, have previously been dissolved in a little water. The whole is heated for eight or nine hours to 270°, stirring constantly, the mass in this time having become almost solid. It is let cool, dissolved in about 500 litres of boiling water, and a certain quantity of hydrochloric acid is added, keeping the liquid at a boil, so that the sulphurous acid formed may escape. The liquid, rendered slightly acid, deposits a little tarry matter. When perfectly cold it is carefully filtered and introduced into an extraction apparatus. This is composed of large copper cylinders containing 250 litres, and all fitted with agitators. These are entirely filled with the liquid to be extracted, and a current of ethylic ether is passed very slowly through them, keeping up a gentle agitation. The ether in its passage becomes saturated with resorcin, and is received in this state in stills, where it is distilled as it enters. This distilled ether is passed again and again through the liquid till entirely exhausted. In the stills the resorcin is found as a colourless liquid, which on cooling congeals to a crystalline mass. To expel the last traces of ether and of water it is heated to 215°, in vessels lined with enamel. The residue when cold forms the commercial product, containing 92 to 94 per cent of pure resorcin, a little phenol, and leaves on distillation about 5 per cent of tarry matter. In this process the water passes over first, then the phenol, and lastly resorcin almost chemically pure. On proceeding as above directed the yield obtained is almost theoretical.

2. *Fluorescein.*—Fluorescein is obtained by fusing 100 parts of resorcin with 75 parts of phthalic anhydride. The mixture is heated to 210° for an hour, let cool, and finely ground. No purification is needed.

3. *Yellowish Eosin, soluble in water.*—Tetrabromfluorescein-sodium.—One kilo. of fluorescein, finely pow-

dered, is stirred up in 10 litres of alcohol; 1·100 kilos. of bromine are then added very slowly, in a slender stream, stirring continuously. All the fluorescein which is already partially bromised is now in solution. A further portion of 1·100 kilos. of bromine is now very cautiously added; each drop which falls forms a crystalline precipitate of tetrabrom-fluorescein. The whole is then left to settle for some hours, and decanted. The crystalline deposit is washed first with a little alcohol to expel the mother-liquor, then with water until completely neutral. It is now stirred up in hot water and carefully saturated with caustic soda, taking care not to render the liquid alkaline. On evaporating this solution tetrabrom-fluorescein-sodium is obtained in a crystalline powder.

4. *Bluish Eosin*, soluble in water.—Tetra-iod-fluorescein-sodium.—Fluorescein is dissolved in alkaline water, and the needful quantity of iodine is added, previously dissolved in dilute soda-lye. The fluorescein and the iodine are then set at liberty by the addition of any acid, and combine instantly, forming a crystalline precipitate of tetrai-od-fluorescein, which is dissolved in dilute caustic soda and evaporated, when it forms the commercial product. An aqueous solution of tetra-iodo-fluorescein does not display the least trace of fluorescence.

5. *Safrosin*, soluble in water.—This is a compound of soda with the bromo- and nitro-derivative of fluorescein, and is manufactured as follows:—9 kilos. of tetrabrom-fluorescein are dissolved in alkaline water, adding 8 kilos. nitrate of soda. The mixture is heated to a boil, and 15 kilos. of sulphuric acid at 66° B. are added. The precipitate is gradually decolourised, and forms a flocculent mass of the colour of manganese sulphide. It is filtered, washed, dissolved in weak caustic soda, and evaporated. It dyes wool a red much more intense and more bluish than does tetrabrom-fluorescein, and if mixed with naphthal (naphthaline?) orange may form an advantageous substitute for cochineal.

6. *Eosin*, soluble in alcohol.—This eosin yields shades much more "bloomy" and more solid than the eosins soluble in water. The methylic derivative of tetrabrom-fluorescein has a tone rather more yellowish than the ethylic. We mix 5 kilos. of tetrabrom-fluorescein with 10 litres of pure methylic alcohol and 9 kilos. of sulphuric acid at 66° B. These materials are heated in a cohobator placed in the water-bath for four hours, and are then poured into a large quantity of cold water, filtered, washed, and the precipitate converted into a potassium-salt, a compound of the methyl-derivative of tetrabrom-fluorescein. This product, when dried, dissolves readily in a mixture of equal parts of water and alcohol. The solution displays a splendid fluorescence.

7. *Resorcin Blue*.—A new derivative of resorcin is a blue, finely dichroic, which gives upon silks a reddish blue shade, beautifully fluorescent.—*Abstracted from Moniteur Scientifique.*

LECTURE EXPERIMENT
SHOWING THE
COMBUSTION OF OXYGEN IN AMMONIA.

By N. T. LUPTON.

A MODIFICATION of the well-known experiment for showing the oxidation of ammonia by means of a coil of platinum wire, furnishes a fine lecture experiment, in which oxygen is made to burn in ammonia with a continuous flame. In the experiment as usually described, a coil of heated platinum wire is suspended in a flask containing a small quantity of a strong solution of ammonia. The wire continues to glow in consequence of the oxidation of the ammonia, nitrite of ammonia being formed. By passing a small tube delivering oxygen to the bottom of the flask the platinum will become intensely heated and a slight explosion will ensue. Bloxam says—"By regulating the stream of oxygen, the bubbles of that gas may be made to burn as they pass through the ammonia at the bottom of the flask." The modification I have made is to allow the end of the tube delivering oxygen from a gas-holder to be about one inch *above the surface of the solution of ammonia*, and the oxygen as it issues will burn gently in the atmosphere of ammonia by which it is surrounded. The platinum coil must be removed from the flask as soon as the flame surrounds the end of the tube conveying oxygen. It requires some care in regulating the flow of oxygen, but when properly adjusted the flame is as distinct and continuous as that from a jet of any combustible gas.

Vanderbilt University,
October 15, 1878.

A TABLE OF OXIDATIONS AND REDUCTIONS.

By HENRY B. PARSONS.

THE table appended shows the action of the principal inorganic acids upon each other, and requires but little explanation. (See next page.)

The reactions embraced in this table are many of them quite complicated, and difficult to remember; also there are many that are not definitely stated in English or American text-books or dictionaries of chemistry. The works most frequently referred to are Gmelin's "Handbook of Chemistry," Watts's "Dictionary of Chemistry," and Douglass and Prescott's "Qualitative Chemical Analysis," second edition. I have also been greatly assisted in this compilation by notes on "Oxidising and Reducing Agents," given to the Pharmacy Classes of 1876-7, by Otis C. Johnson, Instructor in Qualitative Analysis, in this University.

Many of the reactions have been verified by myself, and I have experimented in some cases where I have been unable to find definite authority.

To find the products of the action of one acid upon another, find the name of one of the acids in the column on the left, and follow the line through to the column designated by the name of the other acid. Then find the name of the second acid in the column on the left, and follow its line through to the column designated by the name of the first acid.

The products of the decomposition of both acids will thus be found, and the equation may be balanced in the usual way.

For example let us find the action of nitric acid on iodine. Find the word *Nitric* in the column on the left marked "Acids, &c.," and follow its line through to the column marked *Iodine*. We find that the iodine is changed to iodic acid (HIO_3), but not rapidly, as shown by footnote.

Now, to ascertain what becomes of the nitric acid, we find the word *Iodine*, in the column on the left, and trace its line to the column marked *Nitric*. The nitric acid is changed to nitric oxide (NO). The reaction may then be written as follows:—

$$6I + 10HNO_3 = 6HIO_3 + 10NO + 2H_2O.$$

The table shows the action in neutral or acid solutions, unless otherwise stated.

Because of the frequent use of ferrous and stannous salts as reducing agents, and ferric salts as oxidising agents, I have placed them in the table also.

The author has devoted his spare hours, for nearly a year, to the work of compiling and revising this table, and in doing original work upon it, and now presents it with the hope that it may prove of some use to students pursuing the study of oxidising and reducing agents.

Chemical Laboratory,
University of Michigan.

TABLE OF OXIDATIONS

Acids, &c.	Oxalic.	Nitrous.	Nitric.	Hydrosulphuric.	Thiosulphuric.	Sulphurous.	Sulphuric.
Oxalic	0	NO	NO	0	0	0	0
Nitrous	H_2O+CO_2	0	0	S	$S,,H_2SO_4$	H_2SO_4	0
Nitric	H_2O+CO_2	0	0	$S,,H_2SO_4$	$S+H_2SO_3,,H_2SO_4$	H_2SO_4	0
Hydrosulphuric..	0	NO or NH_4NO_3	NO	0	0	$S+H_2S_2O_6$	$S+H_2SO_3$
Thiosulphuric ..	0	NO	NO	0	0	0	0
Sulphurous.. ..	0	NO	NO	$S+H_2S_2O_6$	0	0	0
Sulphuric ..	H_2O+CO_2+CO	$NO+HNO_3$	0	$S+H_2SO_3$†	$S+H_2SO_3$	0	0
Sulphocyanic ..	0	NO	NO	0	0	0	0
Hydroferrocyanic	0	NO	NO	0	0	0	0
Hydroferricyanic	0	$H_2Fe''(NO)'Cy_5$	$H_2Fe''(NO)'Cy_5$	S	H_2SO_4	H_2SO_4	0
Chlorine	CO_2	HNO_3	0	$S,,H_2SO_4$	$H_2S_4O_6,,H_2SO_4$	H_2SO_4	0
Hydrochloric ..	0	0	$NOCl_2+Cl$	0	$S+H_2SO_3$	0	0
Hypochlorous ..	H_2O+CO_2	HNO_3	0	$S,,H_2SO_4$	H_2SO_4	H_2SO_4	0
Chloric	H_2O+CO_2	HNO_3	0	$S,,H_2SO_4$	H_2SO_4	H_2SO_4	0
Bromine	CO_2	HNO_3	0	$S,,H_2SO_4$	H_2SO_4	H_2SO_4	0
Hydrobromic ..	0	0	NO	0	0	0	H_2SO_3
Bromic	H_2O+CO_2	HNO_3	0	$S,,H_2SO_4$	H_2SO_4	H_2SO_4	0
Iodine	~~CO_2~~ ?	0	NO	S	$H_2S_4O_6$	H_2SO_4	0
Hydriodic	0	NO	NO	0	0	0	H_2SO_3
Iodic	H_2O+CO_2	HNO_3	0	$S,,H_2SO_4$	H_2SO_4	H_2SO_4	0
Hypophosphorous	0	NO	NO	0	0	0	0
Chromic	H_2O+CO_2	HNO_3	0	$S,,H_2SO_3$§	$S+H_2SO_4$	H_2SO_4	0
Permanganic ..	H_2O+CO_2	HNO_3	0	S‡$,,H_2SO_4$	H_2SO_4‡	H_2SO_4	0
Arsenious	0	NO	NO or HNO_2	0	0	0	0
Arsenic	H_2O+CO_2	0	0	S	$S,,H_2SO_4$	H_2SO_4	0

Acids, &c.	Bromine.	Hydrobromic.	Bromic.	Iodine.	Hydriodic.	Iodic.	Hypophosphorous
Oxalic	HBr	0	$Br,,HBr$	~~HI_2O~~	0	$I,,HI$	0
Nitrous	HBr	0	$Br,,$	0	I	I	H_3PO_4
Nitric	0	Br	Br+O†	HIO_3*	$I,,HIO_3$	0	H_3PO_4
Hydrosulphuric..	HBr	0	$Br,,HBr$	HI	0	$I,,HI$	0
Thiosulphuric ..	HBr	0	$Br,,HBr$	HI	0	$I,,HI$	0
Sulphurous.. ..	HBr	0	$Br,,HBr$	HI	0	$I,,HI$	0
Sulphuric	0	Br	Br+O†	0	I	0	H_3PO_4*
Sulphocyanic ..	HBr	0	$Br,,HBr$	HI	0	$I,,HI$	0
Hydroferrocyanic	HBr	0	$Br,,HBr$	HI	0	$I,,HI$	0
Hydroferricyanic	0	0	0	0	I	0	H_3PO_4
Chlorine	0	Br	0	$ICl_3,,HIO_4$	$I,,HIO_4,,$	HIO_4	H_3PO_4
Hydrochloric ..	0	0	$BrCl_5 \div Br$	0	0	ICl_3	0
Hypochlorous ..	$HBrO_3$	$Br,,HBrO_3$	0	$HIO_3,,HIO_4$	$I,,HIO_4$	HIO_4	H_3PO_4
Chloric	0	Br	0	HIO_3	$I,,HIO_3$	0	H_3PO_4
Bromine	0	0	0	HIO_3*§	I	0	H_3PO_4
Hydrobromic ..	0	0	Br	0	0	I	0
Bromic	0	Br	0	HIO_3	I	HIO_4	H_3PO_4
Iodine	HBr*§	0	Br	0	0	0	H_3PO_4
Hydriodic	HBr	0	HBr	0	0	I	0
Iodic	0	Br	Br	0	I	0	H_3PO_4
Hypophosphorous	HBr	0	HBr	HI	0	$I,,HI$	0
Chromic	HBr‖§	Br	0	HIO_3‖§	I	0	H_3PO_4§
Permanganic ..	$HBrO_3$‡	$Br,,HBrO_3$	0	HIO_3	$I,,HIO_3$	0	H_3PO_4
Arsenious	HBr	0	$Br,,HBr$	HI	0	$I,,HI$	0
Arsenic	0	0	0	HIO_3	$I,,HIO_3$	0	H_3PO_4

* Action slow and incomplete; not likely to occur in ordinary work.
† Gmelin's "Handbook of Chemistry."
‡ In alkaline solutions.

AND REDUCTIONS.

Sulphocyanic.	Hydroferrocyanic.	Hydroferricyanic.	Chlorine.	Hydrochloric.	Hypochlorous.	Chloric.
0	0	0	HCl	0	HCl	HCl
$HCy+H_2SO_4$	$H_3(FeCy_6)$	$H_2Fe''(NO)'Cy_5$	HCl	0	HCl	HCl
HCy_3S_3,,$HCy+H_2SO_4$	$H_3(FeCy_6)$	$H_2Fe''(NO)'Cy_5$	0	$NOCl_2+Cl$	0	$HClO_4+Cl+O$
0	0	$H_4(FeCy_6)$	HCl	0	HCl	HCl
0	0	$H_4(FeCy_6)$	HCl	0	HCl	Cl,,HCl
0	0	$H_4(FeCy_6)$	HCl	0	HCl	Cl,,HCl
$(HCy)_2S_3$	$HCy+K_2Fe''(FeCy_6)$	0	0	0	Cl	$HClO_4+Cl_2O_4$
0	0	0	HCl	0	HCl	HCl
0	0	0	HCl	0	HCl	HCl
0	0	0	HCl	0	0	0
HCy_3S_3,,$HCy+H_2SO_4$	$H_3(FeCy_6)$	$(Fe_4'''Fe_3'')(FeCy_6)_6'''$**	0	0	0	0
$(HCy)_2S_3$	0	0	0	0	Cl	Cl_2O_4+Cl
$HCy+H_2SO_4$	$H_3(FeCy_6)$	0	0	H_2O+Cl	0	0
$HCy+H_2SO_4$	$H_3(FeCy_6)$	0	0	Cl or Cl_2O_4	0	0
$HCy+H_2SO_4$	$H_3(FeCy_6)$	0	0	0	Cl,,HCl	0
0	0	0	HCl	0	HCl	HCl
$HCy+H_2SO_4$	$H_3(FeCy_6)$	0	0	0	0	0
$HCy+H_2SO_4$	$H_3(FeCy_6)$	0	HCl	0	Cl,,HCl	Cl,,HCl
0	0	$H_4(FeCy_6)$	HCl	0	HCl	HCl
$HCy+H_2SO_4$	$H_3(FeCy_6)$	0	0	Cl	HCl	0
0	0	$H_4(FeCy_6)$	HCl	0	HCl	HCl
$HCy+H_2SO_4$§	$H_3(FeCy_6)$	0	0	Cl or ClO_2Cl_2	0	Cl or Cl_2O_4§
$HCy+H_2CO_4$	$H_3(FeCy_6)$	0	0	Cl	0	0
0	0	0	HCl	0	Cl,,HCl	Cl,,HCl
$HCy+H_2SO_4$		0	0	Cl	0	0

Chromic.	Permanganic.	Arsenious.	Arsenic.	Ferrous to Ferric.	Ferric to Ferrous.	Stannous to Stannic
Cr_2O_3	MnO	0	H_3AsO_3	0	H_2O+CO_2	0
Cr_2O_3	MnO	0	0	NO	0	NO or NH_4NO_3
0	0	H_3AsO_4	0	NO	0	NO or NH_4NO_3
Cr_2O_3	MnO	0	H_3AsO_3	0	S	0
Cr_2O_3	MnO	0	H_3AsO_3	0	$H_2S_4O_6$	0
Cr_2O_3	MnO	0	H_3AsO_3	0	H_2SO_4	H_2S
0	MnO+O	0	0	0	0	H_2SO_3,,H_2S
Cr_2O_3	MnO	0	H_3AsO_3	0	0	0
Cr_2O_3	MnO	0		0	0	0
0	0		0	0	0	$H_4(FeCy_6)$
0	0	H_3AsO_4	0	HCl	0	HCl
Cr_2O_3 or CrO_2Cl_2	MnO	0	0	0	0	0
0	0	H_3AsO_4	0	HCl	0	Cl,,HCl
0	0	H_3AsO_4	0	HCl	0	Cl,,HCl
Cr_2O_3‖	MnO‡‖	H_3AsO_4	0	HBr	0	HBr
Cr_2O_3	MnO,,H_2MnO_4‡	0	0	0	0	0
0	0	H_3AsO_4	0	Br,,HBr	0	Br,,HBr
Cr_2O_3‖	MnO	H_3AsO_4	0	HI	0	HI
Cr_2O_3	MnO	0	H_3AsO_3	0	I	0
0	0	H_3AsO_4	0	I,,HI	0	I,,HI
Cr_2O_3	MnO	0	H_3AsO_3	0	H_3PO_4	0
0	0	H_3AsO_4	0	Cr_2O_3	0	Cr_2O_3
0	0	H_3AsO_4	0	MnO	0	MnO
Cr_2O_3	Mn_2O_3+MnO	0	0	0	H_3AsO_4	As
0	0	0	0	H_3AsO_3	0	H_3AsO_3,,As

‖ In alcoholic solutions.
§ H. B. Parsons, in Douglas and Prescott's "Qualitative Analysis," 2nd ed., paragraph 166.
** "Watts's Dictionary of Chemistry."

PROCEEDINGS OF SOCIETIES.

NEWCASTLE CHEMICAL SOCIETY.

October 24, 1878.

INAUGURAL ADDRESS, by R. C. CLAPHAM, F.C.S.

(Continued from p. 218).

Depression in Trade.

IN the midst of a very serious depression in trade, through which this district in connection with others is now passing, in the face of a great development in all chemical industries on the Continent, where improved methods of working have of late been steadily introduced, a competition has been created which was unknown in former times, but which has been severely felt during the last four or five years. In this state of things it may be interesting to review the progress which has been made, and is now making, to enable these important local industries in which a large amount of capital is embarked, to cope with and overcome their present difficulties, because I think we shall be compelled to admit that we must hereafter look rather to economic working and a reduction of the cost of manufacture than to the hope of high prices. To some extent we have data at our disposal to show the position of the large enterprises, and to compare results with past years. At the meeting of the British Association in this town in 1863, a paper was prepared on the Chemical Industries of the Tyne, Wear, and Tees, by the late Dr. Richardson, J. C. Stevenson, M.P., and myself, and I propose to compare the results there given with those of the present times.

Soda Trade.

Few of our local trades have undergone more extensive changes since 1863 than the soda manufacture with its allied branches, all of which have been greatly modified, not only from causes common to other manufactures, but from many changes and improvements carried out both in the purely chemical processes and in the erection of entirely new and costly plant. These changes have all followed in rapid succession during the last eight or ten years. The revolving Ball Furnace came into use about twenty-five years ago, but its application was limited for several years afterwards, and its construction being then confined to balling only sixty to seventy tons sulphate weekly, it was a mere pigmy as compared to the present furnace, which is constructed for something like 300 tons weekly; but comparatively speaking very few of the small furnaces were at work on the Tyne fifteen years ago, and therefore nearly all the sulphate of soda continued to be balled in the old handworked furnace, using only twenty-one tons sulphate weekly. The present large furnaces were first erected at C. Tennant and Co.'s works at Glasgow, by Mr. Mactear, and have been extensively adopted here of late years. The mixture of materials heretofore used in balling and the times of charging the batch have both been considerably altered since the introduction of the large furnaces, and the changes have resulted in a considerable saving in the chalk or limestone used, and in the turn out of a soda-ash of steady uniform quality, testing from 52 to 54 per cent. The heat of the furnace and of the batch worked have both received much attention, and means are now taken to prevent (or destroy) the formation of cyanides towards the end of the operation, from which the colour of the soda-ash is largely effected.

The Mactear Carbonating Furnace is a still more recent invention, and has come into operation during the last three years, and promises satisfactory results. A furnace of this construction will turn out from 100 to 120 tons weekly (the exact quantity depending on the quality required) as compared to an old furnace turning out 17 or 18 tons. The saving in cost to be effected by these new appliances was at one time expected to be very large, certainly more than one-half of that formerly incurred, but it must be in fairness admitted that owing to the reduction in the price of coal to about the same as in 1871, and the much lower wages now paid, and from other changes, the difference of cost between the old and the new systems is not at present so great as was expected. The heavy outlay incurred, and the gradual liquidation of the amount expended, must also be taken into consideration. But, on the other hand, it must also be admitted that the new furnaces will show much better comparative results in times of greater prosperity than at present when a large production is important, when wages and coals are necessarily higher. The results will depend not so much upon the workmen as upon the amount of steam applied to the furnaces; under these circumstances the comparative results will be more marked. Whilst machinery is taking the place of hand furnaces, both in balling and carbonating, it is remarkable that hitherto in decomposing, the machine-worked furnace has made little progress to what was expected a few years ago. Some of the causes of both failure and success are now laid bare. Practical working has proved the necessity of far more massive machinery than was at first expected to be required, and has shown also a difficulty in keeping the working bed sufficiently level for the machinery in which at one stage an acid liquid, and at another stage a dry sulphate, have to be worked, and there yet appears ample room for improvement in these respects; on the other hand, it is found that in those works where the furnace is kept working for some time without accident, a saving, both in wages and in the consumption of sulphuric acid, is the result.

Other improvements have been made in the more general adoption of the Gay-Lussac apparatus for saving nitrate of soda, and in the erection of Glover towers for the concentration of acid from the heat of the burners, and the more perfect burning of pyrites in the kilns, all of which have brought about a considerable saving. It seems probable that investigations now being made by Davies, Affleck, and others, both for the separation of arsenic from the acid to be used in the Gay-Lussac and Glover towers, and in the loss of nitrous fumes by defective absorption, may hereafter lead to still better results. A patent taken out by Hargreaves and Robinson for the manufacture of sulphate of soda by the direct application of sulphurous acid to common salt, has been worked out in practice by our esteemed member, Mr. J. C Stevenson, M.P., who is now producing from this process about 5950 tons annually. The chief advantages claimed by Mr. Hargreaves are—(1) The saving of capital in building by the non-erection of lead chambers; (2) That nitrate of soda is not required; and (3) That a saving in coals is effected. But to set against the above is the cost of the large metal cylinders required to hold the salt whilst the decomposition is going on, the necessary massive brick-work, and apparatus attached, all of which, I believe, have proved more expensive than was at first expected. The length of time requisite to properly finish the charge, so as to allow of a complete decomposition of the salt, has also added to the first expected cost of coals and wages. The very pure sulphate produced by this process is, however, an advantage for many operations, and must not be overlooked. But a patent which, if successful, would, to a large extent supersede the present plant in chemical works, and the present mode of manufacture, has been carried out for some time past by M. Solvay, at Nancy, in France, which consists in the decomposition of salt in the form of brine by gaseous ammonia and carbonic acid, and the production of a very pure carbonate of soda, which is now extensively used in glass works and other operations where colour is important. This process has also still more recently been established at Northwich, in Cheshire, by Messrs. Brunner and Mond, who are now producing about 12,000 tons per annum. So far as can be learned of this new process,

which may be said to be still in its infancy, it appears as if it might prove an important rival to the old method of working, and its practical application would point to the probable future of the soda trade as being near to the salt brines. If, however, the recent discoveries of Mr. Edison for the universal application of the electric light as a substitute for gas prove correct, and result in the stoppage of gas works, the necessary supply of ammonia to make up the loss in the operations might prove a difficult matter, and, at any rate, the price would be so far advanced as to make the ammonia process impossible to be established at a profit. It is to be hoped that both these interesting and important patents may form subjects or separate papers hereafter.

In the bleaching-powder trade, which is now so extensively carried out here, a great change has been effected in the last eight years, not only in the chemical operations, but also in the erection of new and costly plant. Mr. Weldon's patent for the recovery of the heretofore waste manganese has come into general use, and by this process nearly all the manganese is now being recovered. By the use of presses recently introduced, and working at a pressure of 50 lbs., the last traces of chloride of manganese liquors are separated from the settled mud (chiefly sulphate of lime), and the final loss is reduced to 5 or 7 per cent. The details by this process have so frequently been discussed by the members in past years, that I will now only add a short extract from a paper read by Mr. Weldon before the Society of Arts in 1874. He says:—"I should much like to explain to you what takes place in the fundamental operation of this process—that which is performed in the oxidiser, because it results in the formation of compositions which were not known until they were produced in this process. When I first attempted to press this process upon the attention of manufacturers, I was always met by the objection that as yet I had only performed it in the laboratory, and that many things are possible in the laboratory which on the large scale are impracticable. But, in this process, we have an instance of results being readily obtainable on the large scale, which cannot be obtained in the laboratory, and for some time we never obtained in manufacturing operation a product containing less than a full equivalent of basic oxide for equivalent of MnO_2, which is the product obtained as under:—

$$MnO \times CaO \times O = CaO,MnO_2.$$

But each time the scale of operations was increased the chemical quality improved, until we are now able to make regularly a product containing only one equivalent of base to two equivalents of MnO_2, as under:—

$$\left.\begin{matrix} 2MnO \times HO \times CaO \times 2O \\ 2MnO_2 \end{matrix}\right\} = CaOHO$$

The production of soda, with its allied branches, has greatly increased during the past fifteen years, as will be seen from the following figures. The importation of pyrites from abroad in 1862 was only 43,017 tons, to which must be added pyrites from Ireland and Cornwall, then extensively used, and amounting to 29,783 tons, making the consumption 72,800 tons, whereas in 1877 the importation was 186,757 tons, and after allowing for the manure trade, &c., it leaves a total consumption of 130,000 tons for alkali works, as against 72,800 tons at the former period named. And again, the consumption of salt, which, in 1862 was 90,000 tons, is now (after allowing for eight alkali works which are at present laid in) 192,500 tons, showing in these two articles, which constitute the largest raw materials used, an increase of double the former consumption.

In a paper read before the Society of Arts by Mr. Mactear, when speaking of the total production for Great Britain, he says that in 1862 the production of alkali was 203,000 tons, with an employed capital of £2,000,000, and in 1876 the production was 430,000 tons, with a capital of £7,000,000.

The following are the productions of manufactured articles on the Tyne:—

	1862.	1877. (Approximate.)
Alkali	43,500	.. 89,800
Crystals of soda	51,300	.. 117,000
Bi-carbonate	7,450	.. 7,400
Caustic soda	500	.. 1,500
Bleaching-powder ..	11,200	.. 30,000
	113,950	245,700

(To be continued)

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 17, October 22, 1878.

Thermic Formation of the Compounds of Carbonic Oxide with the other Elements.—M. Berthelot.—The oxide of carbon combines with the elements in the same manner as hydrogen, forming an oxide, carbonic acid, a chloride, carbonic oxychloride, and a sulphide, carbonic oxysulphide. Hence it has been sometimes regarded as an organic radical under the name of carbonyl. The author, without attaching much importance to this view, has examined the heat liberated in these combinations. On comparing the respective combinations of carbonic oxide and of hydrogen with oxygen, sulphur, and carbon, he finds that the relative order of the thermic disengagements is the same, but not their absolute magnitude, nor that of their differences. The heats liberated by the chloruretted and sulphuretted combinations of carbonic oxide are smaller than those from the corresponding compounds of hydrogen, which agrees with their lower stability.

Various Thermic Determinations.—M. Berthelot.—The author has examined boric acid, sodic chromate and biacetate, silicic iodide, and the alkaline-earthy phosphates.

Vision of Colours, and especially the Influence exercised on the Vision of Coloured Objects in Circular Motion, when observed comparatively with Identical Coloured Objects in a State of Rest.—E. Chevreul.—The author, in opposition to Young, Helmholtz, and Plateau, maintains that the primary colours are not red, green, and violet, but red, yellow, and blue, in accordance with the experience of artists and dyers.

Determination of Butter in Milk.—E. Marchand.—A continuation of the controversy between the author and A. Adam.

Mosandrium of Lawrence Smith.—Marc Delafontaine.—The author in a recent memoir on terbium (*Archives des Sciences Physiques et Naturelles*, March, 1878) disclosed facts which place the existence of this metal beyond doubt, and announced at the same time the probable discovery (since confirmed) of a new metal, which he named Philippium, and which is found in Samarskite from the United States along with yttrium. On July 22nd Mr. Lawrence Smith caused a sealed packet to be opened and read before the Academy, in which he laid claim to the priority of this discovery, and gave to the new element the name of Mosandrium. The author, however, contends that the experiments of M. Marignac, and his own, leave no doubt on the identity of terbia and of the so-called mosandric oxide. He sees nothing in Mr. Lawrence Smith's note to justify his reclamation of priority as regards the discovery of the new metal, and maintains that he has first pointed out its existence and its properties.

Researches on the Sulphates.—A. Etard.—The author has obtained numerous bodies of the general formula $M_2(SO_4)_3,NSO_4nSO_4H_2$; also mixed sulphates of the formula $2(SO_4MSO_4N),nSO_4H_2$; and, lastly, certain peculiar simple or double sulphates, more or less hydrated.

Moniteur Scientifique, Quesneville,
October, 1878.

Contributions to the Technology of Chloride of Lime.—Dr. J. Hurter.—The author in this extensive memoir examines the phenomenon of the absorption of chlorine in its variations with time, with the concentration of the gas, with the depth and extent of the layer of lime. Secondly, he inquires into the disturbing influences exercised by the gases mixed with the chlorine,—*i.e.*, carbonic acid,—hydrochloric acid, and watery vapour, and the influence of the heat liberated during the absorption. As concerns the action of time and of the extent of the layer of hydrate of lime, he finds that chlorine is absorbed with a speed which rapidly increases, and that in equal times the proportions of gas absorbed are as the surfaces exposed. Hence he concludes that the depth of the stratum of lime has no influence on the absorption, the chlorine in equal times penetrating to an equal depth. The humidity of the hydrate of lime has at first little influence on the rate of absorption. He gives the following formula:—

$$s = 0{\cdot}305 + 0{\cdot}588\sqrt{P}\,t_1 - 0{\cdot}145,$$

where s signifies the depth of the stratum, which in t hours is converted into chloride of 36 degrees by a chlorine whose degree of concentration is expressed by P. By means of this formula it is easy to calculate the yield of the chambers hitherto used. The influence of the foreign gases he finds very injurious. He holds that the chloride of lime is a peculiar compound, not containing chloride of calcium ready formed.

The chemical notes inserted under the title *Revue Etrangère* are all taken from the Chemical News and from Auerbach's work on Anthracen as translated by Mr. Crookes.

Singular Use of Fluorescein.—To determine whether the head waters of the Danube found their way through subterranean passages into the Aach, a quantity of fluorescein was placed in the former river, and three days later the splendid green colour with golden reflections was quite distinct. Ten kilos. of fluorescein had sufficed to colour, in an indisputable manner, 200 million litres of water.

French Association for the Advancement of Science.—At this meeting, held exceptionally at Paris, the President, M. Frémy, selected the manufactures of soda and of steel as the subject of his discourse.

Chemical Industry at the Paris Exhibition of 1878: Anthracen and Artificial Alizarin.—Adolphe Kopp.—A survey containing little, if anything, which is not already familiar.

Reimann's Färber Zeitung,
No. 39, 1878.

New Colouring-matters.—According to a report presented to the Prize-Jury of the Paris Exhibition, by P. Monnet and Co., of La Plaine, near Geneva, the trade names Scarlet (écarlate) and Hortensia are applied to substitution derivatives of fluorescein into which bromine and hyponitric acid are simultaneously introduced. The Scarlet serves for wool-dyeing, whilst Hortensia can be equally well fixed upon cotton, silk, and wool. Pyrosin I is pure bi-iodo-fluorescein; pyrosin R is a mixture of -bi and tetra-iodo-fluorescein. Both give a fine ponceau colour, though tetra-iodo-fluorescein alone gives shades more approaching to violet. Rose Bengale, Phloxin, and Cyanosin are rose-coloured dyes, which are bromo- and iodo-derivatives of fluorescein. Rose Bengale, which was discovered in 1876 by Nölting, and phloxin are not soluble in water; cyanosin is soluble in alcohol. Since 1877 the same firm offers the soda-salt of benzyl-fluorescein under the trade name of Chrysolin. It was discovered by their chemist Reverdin, by the action of phthalic acid along with sulphuric acid upon a mixture of chlor-benzyl and resorcin. The colouring-matter is soluble in water, and is easily fixed upon fibres with a fine yellow colour. For fixing the resorcin colours upon cotton, the latter is worked in an alum-bath mixed with soda and in emulsive oils. Acetate of alumina is also a good mordant.

Nos. 40 and 41, 1878.

These issues contain nothing of general interest.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 4, Sept. 26, 1878.

M. Wurtz has presented to the "Committee of Learned Societies" a report on the merit of M. Rosenstiehl as an investigator into the nature of artificial colours, with especial reference to his researches on the tinctorial ingredients of madder.

Co-Chemical Nitrification.—M. Grandeau.—The author mentions an interesting fact observed by MM. Schlœsing and Muntz, that nitrification in sewage is completely suspended by the vapour of chloroform, and hence that it is due to a living organism.

M. Odile Martin has devised an ingenious apparatus for fattening fowls mechanically.

La Correspondance Scientifique.
October 15, 1878.

Atmosphere of Planetary Bodies.—Stanislas Meunier.—The author opposes the view upheld by Prof. Sterry Hunt, that the atmosphere is of cosmical, not terrestrial origin, and is consequently common to all the planets. His principal arguments are the absence of an atmosphere in the moon and the asteroids. He does not, however, consider that the carbonic acid now existing in a combined and solid state has ever been at one and the same time present as a gas.

The Electric Light.—P. Jablochkoff.—In a letter to the Editor, this eminent electrician observes: "In a previous issue of the *Correspondance Scientifique* I have replied to the different questions generally put on the use of the electric light. Others have been since brought forward, one of which is 'At what distance from the source of the electricity can a light be produced?' The answer is very simple. The distance may be as great as is desired, only a conductor of a proportionally greater diameter must be employed, so as not to augment the total resistance of the circuit. I must beg, at the same time, to be allowed a few words on an announcement which has appeared in the American papers, and has been reproduced in some European journals. Thus, in the *Times* of October 8th, we read—'The divisibility of the electric light remained still an unsolved problem; its solution was reserved for M. Edison.' But I have long ago effected the division of the electric light, as is proved by my communications to the Academy of Sciences (December 3, 1877) and to the Physical Society of France (February 1, 1878). This divisibility of the electric light has, moreover, been publicly shown, February 9th, 1878, at a lecture delivered by Prof. Jamin in the great Amphitheatre of the Sorbonne, and, what is more, the system has been at the Exhibition since May 1st, 1878, open to all visitors to the Champ de Mars. In view of this fact I do not think it needless to mention the calculations included in the same announcement, not in order to discuss them, but to make known

my opinion on such estimates. They are of two classes. The opponents of the electric light represent it as excessively costly, Partisans and promoters, on the contrary, put forward figures which cannot be called inexact, but which are merely theoretical, and consequently scarcely capable of being justified by practice, and liable to injure the cause of the light rather than to serve it. The electric light consumes hourly 5 grms. of pencil composed simply of coke and plaster. A ton of the best coke costs 45 francs, and a kilo. of plaster 0·50 centime. Taking these figures for the basis of our calculations, we find that the consumption of my electric light representing 100 gas-burners costs per hour $\frac{17}{1000}$ centime. Or an electric light equal to 10,000 gas-burners costs hourly 0·27 centime, whilst the corresponding amount of gas would occasion hourly an expense of 420 francs. No one can prove these figures inexact, yet I will not venture to put them forward as capable of realisation in practice. Wherever the electric light has been introduced a notable saving has been effected. In the great shops of the Louvre, for instance, where this light has been in action for more than a year, the proprietors have found an economy of 30 per cent, and receive a better light. At the Theatre du Chatelet the proprietor has dispensed with 30 francs worth of gas every evening, and uses instead my system of electric light, which costs him only 14."

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 57, 1878.

Report presented by M. Cloez on Inoffensive Colours for the Decoration of Toys, as prepared by M. Turpin.—The colours in question are chiefly lakes formed by eosin in combination with the earthy or metallic bases. These colours, mixed with chromate of zinc (?) in different proportions, yield bright shades, which may be advantageously substituted for red-lead and chrome-yellows.

Limits of the Combustibility of Gases.—M. Schützenberger.—The author proposes the following law: All other circumstances being equal to every pressure from 0 up to 1 atmosphere, there corresponds a limited length of a gaseous column beyond which the combustion provoked by a spark ceases to be propagated, whilst for smaller distances it is transmitted to the whole mass.

NOTES AND QUERIES.

Extraction of Wool from Rags.—In the "Annual Record of Science and Industry for 1873," it speaks of a process for the extraction of wool from half-wool rags, devised by Dr. Rudolf Wagner, but it is not published in that book. I have searched a number of works on chemical technology, but have failed to find it. I bought a copy of Dr. Wagner's "Handbook of Chemical Technology" (eighth edition), hoping to find it in that, but did not. Will you be kind enough to inform me if it is published in any of his works? or do you know of any work on that subject?—Gerald Cooper.

Thermometric Paradox.—A medical friend asks me if I can give any explanation of the following:—During last summer he placed his clinical thermometer (which registers animal heat very accurately) in the direct rays of the sun beside an ordinary thermometer, both being suspended from the top of the stem and not touching any other object. The ordinary thermometer registered about 120° F., but his clinical thermometer did not show any elevation of temperature. He tells me he has repeatedly confirmed this experiment. I was quite unable to give any explanation, never having heard of such a similar statement, nor of thermometers capable of distinguishing between animal heat and the heat of the sun. I will be glad to hear if you or any of your correspondents can confirm or otherwise such statement and explain.—Thermometer.

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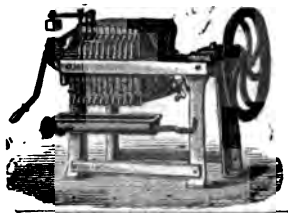

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 990.

PRELIMINARY NOTE ON THE COMPOUND NATURE OF THE CHEMICAL ELEMENTS.

By J. NORMAN LOCKYER, F.R.S., &c.

Reasoning from analogies furnished by the behaviour of known compounds I have discovered that, independently of calcium, many other bodies hitherto considered as elements are also compound bodies.

In communicating this note to the Academy of Sciences, at the meeting which was held on October 28th last, M. Dumas observed that it was the result of three years' assiduous research, in which Mr. Norman Lockyer has, with the greatest care, compared the spectra of the chemical elements with the solar spectrum and other luminous celestial bodies. In the private letter to M. Dumas, accompanying his note to the Academy, Mr. Lockyer announces that he will shortly send the photographs and other details necessary, which will carry conviction to the minds of the Members of the Academy.

OZONE AND THE ATMOSPHERE.*

By ALBERT R. LEEDS Ph.D.

(Continued from p. 225.)

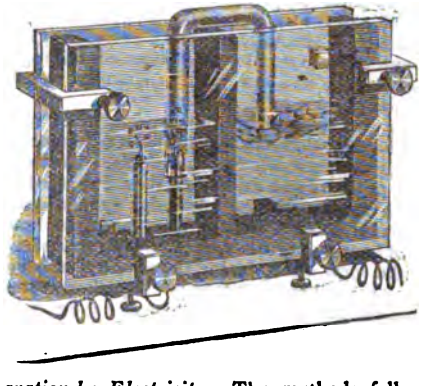
Examination of Methods in Ozonometry.

On resuming laboratory work in autumn, an enquiry, which seemed essential before making any further observations upon atmospheric ozone, was the deportment of the various tests under precise and varied conditions. It was desirable to experiment upon the most convenient method of preparing ozone, upon the precautions requisite for obtaining it in as pure and concentrated a form as possible, and upon the methods of estimating its percentage in an atmosphere of ozonised air or oxygen.

Preparation of Ozone by Electrolysis of Water containing Sulphuric Acid.—Electrolysis was not found a convenient method of preparing ozone in considerable quantities. But it is so important to demonstrate the formation of ozone, according to the reaction which first attracted the attention of Schönbein, that the following novel experiment, which affords an impressive lecture illustration, is important.

A glass tank is made of thin sides of plate glass, and of less height and breadth than the diameter of a magic lantern condenser. These sides are held firmly against rubber walls of about 12 m.m. in thickness, cut out in such manner as to divide the tank into two cells. One is partly filled with acidulated water,† the other with a 15 per cent solution of potassium iodide.

The platinum electrodes from a battery of six Bunsen cells rise from the bottom of the first compartment of the tank, covered, except at their ends, with glass tubes, into which they have been previously sealed. A small bent glass delivery-tube is slipped over the electro-positive pole, its end just dipping beneath the surface of the potassium iodide solution. Decomposition begins as soon as the mixture of oxygen and ozone has displaced the air previously in the delivery-tube, and is made evident by the yellow colour imparted by the liberated iodine. If, before projecting the image of the decomposition on the screen, a few drops of dilute starch have been added, the dark blue clouds, rolling away from the point of exit of the electrolytic ozone, are striking. A tincture of guaiacum, freshly prepared from the solid resin, shows the presence of ozone by a lighter blue colouration spreading across its surface in the tank, and an indigo solution is bleached. The last reaction is not so striking as the foregoing, since the bleaching is necessarily shown by a gradual instead of an abrupt change of colour.



Preparation by Electricity.—The methods followed to submit the oxygen, in as dry and cold and condensed a condition as possible, to the action of electricity, will be given in a subsequent paper. A large Holtz machine, manufactured by Rhumkorff, did not answer satisfactorily as a source of frictional electricity. Examination showed that the surface of the vulcanite supports was coated with a saline incrustation, which proved to be sulphates, probably formed by oxidation of the sulphur contained in the vulcanite, under the influence of ozone generated in the working the machine. This saline matter being hygroscopic, attracted sufficient moisture to destroy insulation.*

The insulation might have been restored by removing the coating: but in the remainder of the experiments I used the improved form of Holtz's machine, made by Messrs. Hall and Benjamin, and obtained excellent results. Various modifications of Siemens's apparatus, and the tube-ozoniser of Prof. Wright,† were employed for ozonising.

Does the Electric Spark Decompose Potassium Iodide?—One of the most interesting points to be determined in connection with the ozone tests, was whether the electric spark alone would decompose potassium iodide, or whether the decomposition was not due to the ozone produced whenever the electric spark is taken in the ordinary manner. To settle this question it was essential to submit the tests to the spark taken either *in vacuo*, or in an atmosphere of some gas which, under the influence of the spark, would neither suffer decomposition nor enter into combination. The first method was attended with insurmountable difficulties, for which reason the second was adopted, hydrogen being the gas selected.

The hydrogen was purified by permanganate of potash solution, as proposed by the author in an articled entitled "Contributions to the Chemistry of Hydrogen" (American Association for the Advancement of Science, August 23, 1876; *American Chemist*, November, 1876).‡ It was dried in the usual manner by sulphuric acid, and then passed over a length of 20 c.m. platinum sponge, which was kept heated at the middle. The farther end of this tube was filled with phosphoric anhydride, which gradually liquefied from absorption of moisture. To make sure that all traces

* From proof sheets of the *Annals of the N.Y. Academy of Sciences*, furnished by the Author.

† According to L. Hoffmann, a maximum liberation of ozone is obtained from a mixture of 1 part sulphuric acid and 5 parts water. (*Pogg.*, 132, 607; *Jahresb. der Chemie*, 1867, 130.) The mixture should be kept as cold as possible.

* This difficulty had been previously noted by Prof. A. W. Wright, *Am. Journ. Sci.*, [3], vol. iv., p. 30.

† *Am. Journ. Sci., Ibid.*, p. 26.

‡ Later by Shobig, *Journ. Prakt. Chem.*, II., xiv., 289, Oct., 1876.

of oxygen had been removed, by entering into combination with hydrogen under the influence of the platinum sponge in the first tube, a platinum sponge guard-tube was added, similar to the first, except that its anterior end as well was filled with phosphoric anhydride. In this guard-tube no change occurred. The tests were contained in an apparatus constructed as follows:—A tube 25 c.m. long and 4 c.m. wide was drawn down at its ends, and fitted very tightly with rubber corks covered with tin-foil. Through these corks glass tubes were passed, conveying platinum poles, the latter sealed to the tubes with only 5 m.m. of their free ends projecting. Two tubes were cemented on one side of the apparatus 6 c.m. from each end, and at the distance of 12 c.m., bent down at right angles. These tubes entered into small wash-bottles containing sulphuric acid, one acting as a seal at the entrance, the other at the exit of the current of hydrogen.

In the first experiment, one specimen of each of the iodised papers was introduced into the apparatus. The hydrogen was then allowed to flow until all the air in the train of purifiers and driers had been displaced. Connection was made with the platinum sponge tubes, and a slow current was allowed to flow for three hours. The object of continuing the current so long a time was not so much the view of displacing the air as of thoroughly desiccating the papers. A stream of sparks was then passed between the poles, which were separated by an interval of 5 c.m.

The papers were pierced with numerous holes, but remained colourless. On opening the apparatus there was no smell of ozone, but an odour as of something burnt. The papers on being moistened developed faint blue stains at the points where pierced by sparks. The experiment was repeated with identical results. Either, then, it appeared, the sparks alone had decomposed potassium iodide, or ozone had been formed in the course of the experiment. That the hydrogen employed still contained oxygen was negatived by the positive results obtained by the platinum sponge guard-tubes, and not less so by the absence of any smell of ozone, this last being, in fact, one of the most delicate tests we possess. But the burnt smell noticed each time the apparatus was opened rendered it extremely probable that the paper, containing as it does the elements of water, had undergone some decomposition.

To eliminate these sources of error, a tube was partially filled with pure potassium iodide, and hung upon the electrodes. After desiccation in a current of hydrogen for many hours, sparks were passed through the iodide for a very long time. The magnificent colour of the spark in hydrogen changed whenever the particles of potassium iodide were rendered incandescent. On testing the iodide afterwards, there was not the slightest indication of liberated iodine. From this it would appear that it is not the electric spark but the ozone generated under its influence which produces the chemical effects of decomposition in this and similar instances.

Collection and Preservation of Ozone.—A bottle with mouth partially covered may be filled with ozonised oxygen by *displacement*. Bottles so filled may be sealed with paraffin, and the ozone preserved indefinitely. Great difficulty was encountered in making tight joints. It has been recommended to insert the ends of tubes to be joined into a wider tube and fill in with paraffin. But the adhesion of the paraffin is so slight that such a joint easily comes apart. A better plan is to take a strip of cotton cloth about 1½ inch wide, and of suitable length, wrap it tightly round the tubes to be joined, fasten with soft flower or copper-wire, and then render it impervious by melted paraffin applied with a feather or brush. Tubes of very different diameters, and vessels of various dimensions, can be joined by suitably modifying this plan.

The action upon india-rubber is very energetic, especially when under strain. This may be illustrated as follows:—A piece of black rubber tubing is coiled tightly around a glass rod, and placed in a bottle through which a current of ozonised oxygen is allowed to flow, the gas entering at the bottom and escaping into the partially closed top. The black colour disappears quickly, a dirty yellow following, and the surface becomes roughened. In a few minutes the edges are serrated, cracks open until the whole tube yields, and it falls into more or less ring-like fragments.

To determine more accurately the amount and kind of change produced in rubber, it was exposed to a slow current of ozonised oxygen (30 litres) for a number of hours. The gas, after passing over the rubber, was made to flow through a weighed sulphuric acid tube, then through a Liebig's bulb and sulphuric acid tube, then through another sulphuric acid tube acting as a guard, and finally through three Geissler bulbs containing solutions of potassium iodide. The time and difficulty in making so many joints tight by the aid of paraffin were great. The results were as follows:—

Porcelain boat + rubber after ozonising	= 7·2523 grs.
„ „ + „ before „	= 7·2415 „
Increase due to action of ozone.. ..	= 0·0108 „
Sulphuric acid tube after ozonising ..	= 12·745 „
„ „ „ before „ ..	= 12·739 „
Increase (probably water)	= 0·006 „
Potash bulbs after ozonising	= 14·620 „
„ „ before „	= 14·6094 „
Increase (probably carbonic acid) ..	= 0·0106 „

The first Geissler tube was dark yellow, the second light yellow, the third colourless. The liberated iodine corresponded to 2·47 m.grm. ozone. This method of estimating ozone is fallacious, and the above experiment is preliminary to a more extended investigation into the nature of the changes occurring in rubber and other organic bodies under the action of ozone.

Preparation by Chemical Methods.—The most noteworthy result arrived at in an examination of these methods was the discovery of a new method of generating ozone. When potassium permanganate and crystallised oxalic acid are pulverised together in a mortar, the heat developed is so considerable as to convert into steam much of the water formed during the course of the reaction. If the salts are introduced into a test-tube, and water added, the escape of gas is at first slow, but it rapidly increases with a corresponding elevation of temperature. Iodo-starch papers held at the mouth of the tube show the presence of ozone in the escaping gases; so do those of guaiacum. Potassium iodide is little affected until the temperature is kept down by holding the test-tube in cold water, when the amount of ozone liberated is so considerable that the papers turn brown at once. Here, then, we have two solid substances which may be kept together for any length of time without change, but on the addition of water liberate ozone. The practical as well as theoretical interest of this discovery is such that a careful study of this and similar reactions is now being made.

(To be continued.)

ON THE PYROLOGICAL EXAMINATION OF ZEOLITIC SILICATES.*

By Lieut.-Colonel W. A. ROSS.

No. II.

IN order to examine these silicates by means of boric acid, therefore, as will be seen from the previous article, the operator has first to crush some fragments between agates to a fine powder, and, treating B.B., a trace of this powder taken up on the hot bead at the point of the blue pyrocone; to observe:—

* These and all operations were made with one of Fletcher's admirable hand-blowers, which I purchased for 7s.

(*a*.) If the fused powder forms an *icy mass* dissolving eventually to a clear bead.
(*b*.) If the fused powder forms a *milky matter*, rendering the bead opaque.
(*c*.) If the fused powder forms a *water-gruelly* matter, with *balls* opaque or clear.

In the case of (*a*) the operator may be certain that he has here an *alkaline aluminous silicate*, which may or may not contain lime or magnesia, &c.* The only exception I know is *Harmotome*, in which baryta seems to act the part of alkali. The distinction is easily made by adding a pin's-head fragment of lime (or a lime borate ball, of which reagent a supply can be easily made and kept). In the *Harmotome* icy mass the lime ball floats uninjured, with hard well-defined edges. In the icy mass from, say, *Labradorite* the lime ball is at once decomposed into milky-white matter, which renders the bead opaque, like white enamel. There is another case of the lime ball remaining intact in the icy mass, *i.e.*, in that formed by *Lepidolite* powder, in which the lithia present seems to prevent the decomposing action of the alumina upon the lime. Examples of these three cases will shortly be given.

In the case of (*b*) the operator may be certain that there is a large proportion of *alumina* present with much or little lime—a matter easily determined by heating some fresh powder in a phospho-boric acid bead—*i.e.*, a boric acid bead which has been dipped hot into deliquesced phosphoric acid—when opaque white balls will shortly appear, as described in the previous paper, numerous and large in proportion to the quantity of lime present. As a saturated solution of pure alumina in a boric acid bead (made by means of a cautious addition of alkali) forms only grey or water-gruelly matter like silica, the *milky matter* of case (*b*) is obviously due to fine particles of milk-white *lime* disseminated through the bead from the decomposed lime-borate ball, so that this reaction is a proof of the presence both of alumina and lime in a mineral. In the case of a *salt*, where there is sufficient alkali to decompose the lime-borate ball, but not sufficient to re-dissolve the milky matter thus evolved, there may, of course, be no alumina present. To find if there is, crush the milk-white opaque bead in the (*a*) forceps (*vide* "Pyrology," page 69) and apply some small fragments B.B. to a fresh boric acid bead. If the milkiness was due to alumina, milkiness will again supervene in the fresh bead, *i.e.*, there will be no change; but if due to alkali without alumina, clear balls will immediately form, the alkali being taken up by the large proportion of fresh boric acid—an expected result.

In the case of (*c*), as in the result of applying the powder of such minerals as *Apophyllite*, *Wollastonite*, &c., to a boric acid bead, the operator sees at once that he has here a lime or lime-magnesian silicate *without* alumina, which may or may not contain alkali; a fact easily determined by the pyrochrome or coloured flame given by a fragment of the mineral, *per se*, except as regards the presence of soda, because nearly all silicates thus give a yellow flame, but this point again is settled by the yellowing of the normal green boric acid pyrochrome, when we may be *quite certain* that soda is present.

The silicic acid is diffused as a water-gruelly matter through the bead, presumably on account of a shameful desertion by its former partner, lime, who, like a fickle Lothario, prefers boric acid to it in this temperature, while alumina seems more like a rival suitor for the attractions of boric acid, with which, under great heat, it even attempts a kind of ball formation; at all events it undoubtedly exercises, even when present in the most trifling proportion, a decomposing effect upon calcium borates in a bead of boric acid, which constitute therefore a most delicate test, qualitative and quantitative, for alumina.

I now proceed to give examples from my notes:—

No. 1. *Labradorite* (Sept. 1, 1878).

(1.) A large trace L. powder to boric acid bead, B.B.
  (*a*.) A siliceous mass at first, changing after O.P. to an icy mass. (*An aluminous alkaline silicate.*)
  (*b*.) More O.P. Glass clear and very vitreous.
(2.) Boiled (1 *b*) in Al capsule,† to eliminate the alkali).
  (*a*.) Boiled to a thick, white, blanc-mangey jelly.
  (*b*.) Solution (acid) extracted by slips of blotting-paper placed over the capsule, like syphons.
(3.) Residue white, jelly-like, thrown on agate slab, dried on platinum spatula, and treated in phosphorised boric acid bead.
  (*a*.) Creamy but bluish white matter; spreading.
  (*b*.) More O.P. Shining particles begin to appear.
(4.) Vesiculated (3 *b*). (See "Pyrology," p. 92.)
  (*a*.) Several minute, clear, round balls: one—pretty large, but egg-shaped—extracted from the vesicle by pliers, and boiled in Al capsule.
  (*b*.) An irregular double or twin roundish mass, full of transparent particles? Bead water-gruelly.
(5.) The oval mass (4 *b*) in fresh boric acid.
  (*a*.) Became gradually opaque white; then lost its rounded form, and became a fat-like mass with fringed edges (Al phosphate?).

[Thus we see that the effect of the alkali of *Labradorite* (which cannot be altogether removed) seems to be to cause a combination of the P_2O_5 with itself and the Al_2O_3, leaving the *lime* free to effect a combination with the boric acid.]

No. 2. *Lepidolite* (Sept. 10, 1878).

(1.) *Appearance.*—Scales like those of mica.
  (*a*.) Obtained a fine powder by rubbing several scales on a file, and tapping gently on an agate slab.
(2.) Trace of this powder in a B acid bead, B.B.
  (*a*.) A siliceous mass, dissolving to a clear, vitreous, yellowish bead—yellow-hot. (*An alkaline, aluminous silicate, with iron.*
  (*b*.) Pyrochrome of the bead green, unchanged. (*Alkali, not soda.*)
(3.) Vesiculated (2 *a*), breathed on the vesicle, and reheated in O.P.
  (*a*.) An intense green fluorescent light. (*Presence of fluorine.*)
(4.) Fragment of lime applied, B.B. to (3 *a*).
  (*a*.) Hard-outlined clear ball, with slight water-gruelly matter round: no milky matter. (*Shows that a barium or lithium aluminous silicate is present.*)
(5.) Fragment of baryta applied, B.B. to (4 *a*).
  (*a*.) Bead almost immediately milk-white, opaque; clear-hot. Barium borate-ball completely decomposed. (*Considerable proportion of alumina.*)
  (*b*.) Vesiculated; no balls observable.
(6.) Fresh L. powder, dissolved B.B. in boric acid; the bead boiled; the residue washed, dried, and heated B.B. in phosphorised boric acid bead.
  (*a*.) No balls; vesiculated, no balls. (*Absence of lime, magnesia, &c*
(7.) A scale of L. heated in Pt forceps, and touching the wick of a pyrological candle, dyed the whole pyrocone a deep crimson colour. (*Presence of lithia.*)
(8.) L. powder dissolved in phosphoric acid, B.B., and the bead held over the base of the gas pyrocone.
  (*a*.) A temporary but distinct violet tinge. (*Presence of potash.*)
  N.B. This is a new test for potash, showing it even in presence of soda.

It is not necessary to give accounts here of the behaviour of *Wollastonite* or *Apophyllite* in boric acid, more especially as they will be found under the proper heads in "Pyrology."

The behaviour of *Zoisite* (case *b*) in boric acid will be given, with other examples, in another article.

London, November 13, 1878.

* *Analcime* is a case of an icy mass, in the formation of which lime has no part.

† These little aluminium capsules, made by Messrs. Griffin for 1s. *require no spirit-lamp.* A bead of boric acid is boiled down without spirting in one, *before the blowpipe*, in fifteen seconds.

"*On the Occurrence of certain Nitrogen Acids amongst the Products of Combustion of Coal-gas and Hydrogen Flames*," by L. T. WRIGHT. The apparatus of the London Gas Referees for determining the sulphur in coal-gas was used by the author throughout his experiments. The combustion of 1000 litres of ammonia-free coal-gas in a Bunsen burner gave 0·00058 grm. nitrogen as HNO_3 and 0·00058 as HNO_2. 1000 litres of coal-gas charged with ammonia gave 0·01071 grm. N as HNO_3 and 0·00168 grm. N as HNO_2. The combustion of 1000 litres of coal-gas charged with ammonia, in a normal atmosphere, in a Bunsen burner with air-holes closed, gave 0·01595 grm. N as HNO_3 and 0·00238 grm. as HNO_2. The combustion of 1000 litres of ammonia-free coal-gas, in an atmosphere charged with ammonia, in a Bunsen burner gave 0·03938 grm. N as HNO_3 and 0·1115 grm. as HNO_2. When hydrogen passed over strong sulphuric acid was burned in an ordinary atmosphere, about 0·013 grm. N as HNO_3 and 0·0002 grm. N as HNO_2 were produced per 1000 litres. When the air was thoroughly purified by passing over strong sulphuric acid, &c., no nitric acid and less than 0·00001 grm. N as HNO_2 were obtained. By a still more efficient purification of both hydrogen and air the condensed water was obtained free from nitrates and nitrites. The author, in conclusion, expresses his belief that the origin of the nitrogen acids found in the condensed water procured by burning coal-gas or hydrogen in air is ammonia either free or combined.

Dr. FRANKLAND said that the experiments just detailed raised some interesting points as regards the combustion of coal-gas. In the combustion of ammonia-free coal-gas the temperature never rose high enough to cause the oxidation of any large amount of nitrogen. An interesting experiment on the subject was the following:—If a jet of hydrogen be lighted in a glass bell-jar no red fumes are formed, but on adding oxygen to the atmosphere an increase of temperature soon produces perceptible red fumes in the bell-jar. In connection with the arc of the electric light, the temperature of which must be enormously high, it would be most important and interesting to determine whether any oxides of nitrogen were formed, and in what quantity.

"*On the Action of Bromine upon Sulphur*," by J. B. HANNAY. In former papers the author showed that when sulphur and bromine were distilled together distillates of any desired composition might be obtained, but that the residue was never free from bromine. The author in the present note attributes this retention of bromine to the sulphur passing into the viscous state, and finds that at 15° complete dissociation can be effected.

"*Researches on Dyeing: Part I., Silk and Rosanilin*," by Dr. MILLS and G. THOMSON. The authors have investigated the nature of the transaction which occurs when a vat is exhausted of its tinctorial ingredients. The experiments consisted in immersing a constant area of white silk in a solution of rosanilin acetate, &c., at a constant temperature for varying times, and determining the loss of strength of the rosanilin solution. They have arrived at the following conclusions:—(1) That when silk is dyed with rosanilin salt that salt is deposited as a whole. (2) That a boiling weak solution of rosanilin salt may undergo dissociation so as to become quite colourless; in which state, however, the dissociating force is wholly overcome by a silk. (Silk is dyed red by immersing it in a solution containing 0·0000003 grm. in 1 c.c., previously rendered colourless by boiling for half an hour.) (3) That for periods of four days, at the ordinary temperature, a magenta-vat is exhausted at compound interest. (4) That the rate of exhaustion of a magenta-vat is retarded by sodic or potassic chloride, and not improbably to an equal extent by equal weights of those chlorides.

"*Comparisons of the Actions of Hypochlorates and Hypobromites on some Nitrogen Compounds*," by H. J. H. FENTON. Both the above reagents act rapidly on ammonium carbamate, but as with urea, only half the nitrogen is evolved with hypochlorite, whilst hypobromite causes the evolution of the whole of that gas. The residue from the hypochlorite does not contain nitrogen as a cyanate, but probably in the form of sodium carbamate. Guanidin yields to both reagents two-thirds of its nitrogen. The residue behaves like that from the action of hypochlorite on urea. Biuret gives one-third of its nitrogen with hypochlorite and two-thirds with hypobromite; the residues resemble those from urea. The author's results are given in the following table:—

	Urea.	Ammonium Carbamate.	Guanidin.	Biuret.	Ammonia Salts.	Cyanates.
NaClO evolves / NaBrO	⅓ / All	⅓ / All	⅔	⅓ / ⅔	All / All	None. / None.

In conclusion the author discusses the formulæ of the above bodies.

"*Notes on two New Vegeto-alkaloids*," by F. VON MÜLLER and L. RUMMEL. Alstonin is obtained from the alcoholic extract of the bark of *Alstonia constricta*. It forms an orange-yellow brittle mass, of a bitter taste, melts below 100° C.; is soluble in alcohol, ether, and dilute acids, sparingly soluble in water. Dilute solutions have a strong blue fluorescence, which is unaffected by acids and alkalies. It is precipitated by the usual alkaloid reagents. Duboisin is a volatile alkaloid obtained from the leaves and twigs of *Duboisia myoporoides*, by a process similar to that employed for the extraction of nicotin. Duboisin is probably identical with Staiger's piturin. Duboisin is a yellowish oily liquid, lighter than water, with a strong narcotic odour and alkaline reaction; very soluble in ether, alcohol, and water. It is not precipitated by phospho-molybdate of soda, picric acid, or platinic chloride.

"*On the Determination of Lithia by Phosphate of Soda*," by C. RAMMELSBERG. Berzelius detected lithia in Carlsbad water by evaporating the solution of the alkalies with phosphoric acid and sodium carbonate. On treating the whole with water an insoluble phosphate of sodium and lithium remained. This double salt the author has shown to be a variable mixture of the two phosphates. Mayer, however, contradicted these results and denied the existence of a double phosphate, and contended that the above residue was pure lithium phosphate. The author has repeated his former experiments and completely confirmed them, preparing synthetically double salts having sodium to lithium as 1 to 3 or 9 to 2, and therefore the author concludes that lithium cannot be determined by Mayer's method, which is also recommended by Fresenius. The employment of this process for the estimation of lithium in micas has led to too high a percentage of lithium. The author, in conclusion, gives analyses of micas, especially as regards lithium; the lithium and sodium chlorides being separated by treatment with ether alcohol, as suggested some time ago by the author.

The Society then adjourned to November 21st, when Dr. Tidy will read a paper on "The Processes and their Comparative Value for Determining the Quality of Organic Matter in Potable Water."

Papers announced: "A Chemical Study of Vegetable Albinism," by Prof. Church; "Researches on the Action of the Copper-Zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe; "On a New Gravimetric Method for the Estimation of Minute Quantities of Carbon," by Drs. Dupré and Hake.

PHYSICAL SOCIETY.

November 9, 1878.

Professor G. C. FOSTER, Vice-President, and afterwards Prof. W. G. ADAMS, President, in the Chair.

THE following candidate was elected a member of the Society:—Sir Frederick Elliot.

Prof. W. G. ADAMS explained a simple appliance made by Mr. S. C. Tisley for exhibiting the coloured bands due

to interference with thick plates. The bands due to regular reflection and refraction were produced by two thick plates nearly parallel to each other and fixed in a brass box with rectangular apertures on its flat faces, so that the light fell on the first plate at an angle of 60°, the whole apparatus being of a convenient size for the waistcoat pocket. On a previous occasion (June 23, 1877) Prof. Adams exhibited these bands to the Society, but not in a portable form. The elliptical interference bands, due to the scattering or diffusion of light at a point on the front surface of one of the plates, were shown by means of a precisely analogous arrangement, except that the inclination of the plates to each other was somewhat greater; in this case the interference bands formed by *regular* reflection and refraction fall in another direction, so that they are not received by the eye; the diffusion interference fringes obtained were clearly visible when thrown on the screen. They are formed by rays once diffused from points on the first surface, and afterwards regularly reflected and refracted from the front and back faces of the two plates in succession. Prof. Adams pointed out that this instrument would form a convenient means of obtaining polarised light in cases where the length of a Nicol's prism is objectionable, for instance, under the stage of a microscope; the light will be completely polarised if the plates be placed to receive the light at the polarising angle, and the field will be much brighter than when a plate of tourmaline is employed.

Prof. W. F. BARRETT exhibited and explained Edison's Micro-tasimeter and Carbon Telephone. In the course of a brief recapitulation of the history of these instruments he referred to Th. du Moncel's early observations, published in 1856, that variations in the resistance of a circuit can be produced by varying the pressure on metallic surfaces in contact, and. after referring to Clèrac's plumbago rheostats, he stated that Edison was probably the first to apply the diminished resistance of carbon under pressure to a practical use, which he did early in 1877 in his carbon relay, the progenitor of the carbon rheostat, micro-tasimeter, and carbon telephone. In all he uses compressed lampblack, a bottom of which may be formed as follows:—The wick of a paraffin lamp having been cut so that it smokes, a quantity of lampblack is formed in the chimney; the lower portion, which has the more intense black colour, is collected from time to time, and all brown particles must be carefully removed, since they offer a greater resistance. The mass is compressed into a disc about the size of a sixpence, crushed, passed through a fine sieve, and again compressed; and this operation may be two or three times repeated in order to attain to perfect uniformity. The original form of tasimeter, in which the hard rubber or other substance was placed horizontally, has been modified so that the whole is vertical. The carbon button rests on a smooth metallic surface in connection with a binding screw, and a similar conducting surface rests upon it leading to a second binding screw. A strip of hard rubber, 1 inch long, $\frac{1}{2}$ inch wide, and $\frac{1}{16}$ inch thick is supported vertically above it, its upper end being attached to a fine screw worked by a tangent screw with graduated head. The whole is enclosed in a heavy conical brass box. Prof. Barrett suggested that it would be preferable to make this jacket cylindrical, and that the apparatus should be inverted, because the weight of the strip on the button is found to prevent the needle of the galvanometer returning at once to zero. Employing one Daniell's cell and inserting a shunt, Wheatstone's bridge and resistance coils in the circuit, it was shown that the hand at some distance caused a considerable deflection, and Prof. Barrett stated that in a still room the instrument becomes so sensitive as to be almost unmanageable. By replacing the hard rubber by a strip of gelatine varnished on one side, a very slight change in the hygrometric state of the atmosphere can be detected by the absorption of moisture causing expansion of the gelatine, and, therefore, compression of the carbon. Its action as an aneroid baroscope was suggested by Prof. Barrett, the button being associated with an exhausted box. He pointed out that before the tasimeter can be used as a measuring instrument, experiments must be made in order to ascertain the exact relation between the resistance of carbon and the pressure to which it is subjected. The carbon telephone, full particulars of which will be found in the current number of *Nature*, was next described; and Mr. ADAMS, Mr. Edison's assistant now in England, exhibited a complete transmitting apparatus with call, &c. A very ingenious and simple form of shunt, received from Mr. Edison with the tasimeter, deserves mention. A row of brass studs fixed on a board are united by plugs, so that if the current enters at one end it can pass out at the other without meeting with any appreciable resistance. But if a plug be removed it throws in about 4 inches of a resisting wire wound over two rows of pins underneath the board, one row of which are in metallic connection with the studs. Thus the entire length of wire is in circuit when all the plugs are removed. Finally, Prof. Barrett mentioned that a communication has just been received from Mr. Edison stating that he has succeeded in arranging an efficient receiving instrument, in which no form of magnet is employed.

Mr. LADD then showed several forms of Electric Lamp, arranged so as to render the use of clockwork unnecessary. In that known as Wallace's workshop lamp the spark passes between the edges of two plates, the lower one being fixed, while the upper one is lifted to a suitable distance by an electro-magnet, brought into action immediately on the passing of the current. A second form, in which an annular magnet was employed, acted on the same principle, the armature carrying the upper plate being specially arranged so as to give a maximum of attractive force. In the third form, the V-lamp, two rods of graphite were inclined at an angle of 45° to the vertical resting in contact on a piece of china. Immediately on the current passing an electro-magnet is caused to act, and after the rods have been firmly gripped they are separated and the support removed. Should the circuit be broken they will at once fall together.

NEWCASTLE CHEMICAL SOCIETY.

October 24, 1878.

INAUGURAL ADDRESS, by R. C. CLAPHAM, F.C.S.

(Concluded from p. 231).

Sundry Trades.

IN the Cement trade, which now forms an extensive local industry, the production in 1862 was 12,000 tons; and I now find, according to an authority on whom we can rely (Mr. John Watson), that the production for the present year is 61,000 tons. In the manure trade, which is an equally important branch of business, the production in 1862 was 15,000 tons, and for the present year 51,000 tons. I am indebted for much useful information on this head to Mr. Henry Bell and Dr. Merz. In the soap trade —a very old local manufacture, dating as far back as 1770 —the production in 1862 was 6000 tons, but from information supplied by Mr. E. A. Hedley, owing to the stoppage of one or two soap works the turn out is not now more than 3200 tons. During the last few years two new and important additions have been made to our local industries. At Middlesbrough, Jones and Co. have commenced the manufacture of oxalic acid, and I believe their works are the largest in England for this purpose; and on the Tyne, Messrs. Redmayne have commenced the manufacture of acetic acid.

So far we have had to record an almost universal increase in chemical productions, but we have now to look at another side of the picture, where some trades have partially died out. The copperas trade, which was begun in this district as early as 1748, and which flourished for 120 years, and in which seven works on the Tyne were at

one time occupied, now only produce 1100 tons annually. The alum business, at one time a very extensive trade, and one of the oldest, established on the Yorkshire coast in 1460, and in which three large works were occupied on the Tyne, has disappeared altogether from the Yorkshire coast, and now only survives in one work in this locality. The prussiate of potash business, in which a considerable capital was at one time embarked, has entirely gone, its products being superseded by colours from coal tar. The Epsom salt trade has also left the Tyne, but has been extensively established at Middlesbrough, where the production is 3000 to 4000 tons annually.

The important trade in glass, established here in the fifteenth century, has fallen off to a serious extent, and the large glass works at St. Peter's and other places for crown glass have ceased to work. The large bottle trade has also decreased considerably; and of the forty-seven bottle houses in 1862, according to Mr. Alderman Ridley, only ten now remain at work, but plate-glass and pressed glass both continue to be produced to a considerable extent.

Copper Trade.

Turning now to the metallurgy of the district, we find that in 1862 the quantity of copper made on the Tyne was only 700 tons, and chiefly produced by the old method of smelting burnt pyrites containing only small percentages of copper (about 1·2 to 1·8 per cent), but mixed with richer imported copper ores. The "wet process" for the extraction of copper, which was only just coming into operation on the Tyne, was afterwards greatly stimulated by a yearly importation, now reaching 180,958 tons of Spanish and Portuguese pyrites, containing about 3½ per cent copper, 48 per cent sulphur, very little silica or other impurities, and which was peculiarly well adapted for the wet process; and these ores in time altogether superseded the non-cuprous ores which had hitherto been imported from Belgium, Ireland, and other places, and the produce of copper has gradually increased from 700 tons to 7500 tons per annum.

In all Spanish pyrites there is found small quantities of silver and gold, varying in some ores, but existing to the extent of about half-an-ounce to the ton of calcined ore. Silver is now successfully produced by M. Claudet's patent by one work on the river, and it is possible that this branch of metallurgy may hereafter be increased. Improvements have been effected of late years in the calcining and treatment of the burnt ores, in the quantity of coals used, and in the amount of wages paid, so that the cost of manufacture has been much reduced; and when the oxide of iron produced ("Blue Billy") is allowed for, I believe it may be stated, without any doubt, that the copper trade of the Tyne can hold its way, both in quality and price, against the ordinary dry smelting process of other localities, although, at the present time, the English copper trade has to contend against an unusually severe competition from Chili and Australia, which has reduced the price of copper to a point hardly before known in this country.

Lead Trade.

The increase in the production of manufactured lead on the Tyne since 1862 has been very considerable, and like some other local enterprises it has, in many of its branches, undergone changes to meet the times.

The separation of the silver, which had been conducted for many years in accordance with the late H. L. Pattinson's patent, in which the crystallisation of the lead in a metal pot was worked by hand labour, has been to some extent superseded by Rozan's patent, in which operation steam is applied as an agitator in the pot where the crystallisation of the pure lead takes place, in lieu of hand-labour, and in other respects it produces a chemical change, and facilitates the work. I shall not further refer to this patent, as we shall shortly be favoured with a paper on the subject by our esteemed member, Mr. Norman Cookson. The most striking change in this respect is the adoption by Mr. Leathart of the patent of M. Flach for the separation of the silver by means of zinc, which is found to wash the melted lead entirely free of the silver contained in it, and the mixture of silver and zinc floats to the top of the pot and is skimmed off. When this process is completed, the mixture of zinc and silver is treated in accordance with M. Guillem's patent, and is placed in plumbago crucibles in a furnace, and the zinc is distilled off and collected in small metal chambers, where it cools in the form of cake-zinc, and is fit for use again. By this means about half of the original zinc used is at present obtained, but it is expected shortly that means will be taken to collect the remainder also. Both these ingenious processes are extremely simple and appear to be most effective. In the manufacture of white-lead a new method has also been worked out by Mr. Leathart, in the adoption of Milner's patent, which consists in subjecting very finely ground litharge in a mixing vessel to the action of salt brine, producing chloride of lead and caustic soda. This mass is then run into an iron vessel, into which carbonic acid is pumped, causing a further chemical change in the production of carbonate of lead and common salt once more, the latter of which is washed out from the white-lead, and may be used over again in the first operation. The patent white-lead produced in this way appears to be very white and chemically pure, but is not quite so heavy as the white-lead made by the old process. At the present time the lead trade is subject to considerable competition. America is now exporting lead, instead of, as formerly, being an importer. Steamboat communication, with the present low freights, has really brought the shipping ports of America almost as near to the Tyne (as far as cost of carriage is concerned) as the well-known lead-mining district of Alston Moor. The lead ores that have recently been discovered in Colorado and Nevada, which are unusually rich of silver, are now being extensively worked, and it is reported that the silver alone in these ores is sufficient to realise a large profit, so that the lead can be set aside as dross, or at any rate sold at a low price for exportation.

The production of manufactured lead on the Tyne is as under:—

	1862.	1877.
White-lead	7500	12,000
Red-lead	4500	6000
Litharge	800	1000
Sheet lead	4500	11,000
Lead pipes	1500	2500
Shot	750	1000
	19,550	33,500

I am much indebted to Mr. J. Leathart, Mr. Warwick, and Mr. N. Cookson for valuable information concerning the lead trade.

Iron Trade.

In referring to the iron trade, which now forms so important a manufacture in the North of England, I shall be obliged to confine myself, from the largeness of the subject, simply to the change which is taking place in the substitution of steel for iron, as its production may fairly be claimed as a chemical operation. The Bessemer process for making steel is now being successfully carried out at Middlesbrough, where steel railway-rails are produced at a price certainly not exceeding £1 per ton above ordinary rails, and which, according to Mr. T. E. Harrison, possess a life three times that of the old rail. Steel plates for boilers and shipbuilding are made by Siemens's patent, and now supplied at prices which may ultimately supersede, for these and other purposes, the ordinary boiler plates. Hitherto, however, the steel made in England has been made from hematite iron ores, or from iron ores brought from Bilbao in Spain, or other places where ores free of phosphorus can be obtained. But important experiments have been conducted, and are now going on, with pig-iron from Cleveland, with the object of separating the phosphorus in it, which averages about 1·5 per cent. At the meeting of the Iron and Steel

Institute, held in this town in 1877, an interesting paper was read by Mr. I. L. Bell, M.P., describing a process by which Cleveland iron, mixed with a certain weight of oxide of iron, and kept at a moderate melting heat, was found to liberate a large part of the phosphorus, whereas at a high heat the phosphorus was retained. In a letter recently received from Mr. Bell, he says: "I have succeeded, by means of oxide of iron at moderate temperatures, in removing 96 per cent of the phosphorus in pig-iron, containing 1·5 per cent of this substance, while not more than 4·5 per cent of the carbon was effected, although it existed to the extent of 3·5 per cent in the pig. The silica was almost entirely carried off as SiO_2." Whether these results will lead to their practical application is yet to be seen, but there can be no doubt of the extreme importance of Mr. Bell's experiments if they succeed in making Cleveland iron applicable to the manufacture of steel, and we may wish our eminent member success in his labours. Other processes for the separation of the phosphorus are also being worked out by manufacturers, and there therefore appears little doubt that in time we shall have steel made from north country iron.

Papers Read.

During the last winter session there were altogether eight papers read before the members, and amongst them I may refer first to two important papers on the action of the Glover tower, and on nitrous acid compounds generally —the one by Mr. James Mactear, and the other by Dr. George Lunge, of Zurich. Although the conclusions arrived at by the authors differed, there can be no doubt that the subjects embraced in the two papers were ably handled, and are well worthy of further investigation. Gay-Lussac has long since taught us that at least two-thirds of the nitrate of soda at one time thought necessary may be saved by the use of his well-known tower. But in the present day further reliable investigation appears necessary to account exactly for the remaining third, and to suggest remedies for its loss. It is to be hoped that the authors will give us additional papers at a future time on this subject. We had also an interesting paper by Mr. Mactear "On the New Revolving Ball Furnace," and the "New Carbonating Furnace," which bear his name, and which have already been referred to. Mr. John Pattinson read a valuable paper "On the Quality of Small Coals used on the Tyne," which will prove of use hereafter; Mr. J. W. Swan, "On a New Form of Water-jet Aspirator;" Mr. John Watson, of Seaham, "On the Purification of Rivers," a large and important subject, in a sanitary point of view; Mr. John Morrison, "On the Manure Trade;" and Mr. J. T. Dunn, "On Indicators in Alkalinity," which are all important contributions to our knowledge, and will be found in the *Transactions* of the Society for last year.

In concluding this paper I have to ask your indulgence for many omissions, and have, at the same time, to thank you for your patient attention to the few imperfect remarks which I have ventured to address to you.

CORRESPONDENCE.

OZONE AND THE ATMOSPHERE.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xxxviii., p. 224) there appeared a paper on the above subject, in which the author (Albert R. Leeds, Ph.D.) seems to have fallen into an error committed by many other observers, namely, that of estimating as ozone everything in the atmosphere capable of colouring so-called ozoscopic papers. I have so repeatedly pointed out this error in the publication of researches on the oxidation of terpenes and similar hydrocarbons, that scientific men, at least, might be reasonably expected to avoid it.

Curiously enough, the very facts mentioned in Mr. Leeds's paper afford evidence of the truth of my statements. He has observed that the atmosphere in the neighbourhood of pine woods is particularly rich in what he regards as ozone, but what I have shown to be peroxide of hydrogen formed during the atmospheric oxidation of the turpentine which is being constantly volatilised into the atmosphere.

One cannot deny the constant occurrence of atmospheric conditions under which ozone would presumably be formed, but, in my opinion, peroxide of hydrogen is a far more abundant and more effectual natural purifier.

Trusting, Sir, you will insert these few words, for the sake of accuracy in chemical observations, I am, &c.,

C. W. Kingzett.

12, Auriol Road, West Kensington,
November 11, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Justus Liebig's Annalen der Chemie,
Band 194, Heft 1.

On Ultramarine.—Dr. R. Hofmann.—Theoretical investigations with the view of determining the constitution of ultramarine. The author, however, quoting some of the formulæ for natural silicates proposed by Hanshofer, admits that they "belong in the realms of fancy rather than in those of sober research."

Action of Alcoholic Potassa upon Bromoform.—H. Long.—The author's results show that ethylen and carbonic oxide, although produced by the action of potassa from two distinct bodies, namely, alcohol and bromoform, bear to each other the simple stœchiometrical relation of 1 : 3 molecular weights.

On Hypophosphorous Acid and its Salts. (Second Treatise.)—Th. Salzer.—Concerning the preparation of the acid the author remarks that only about one-fifteenth of the phosphorus employed is converted into hypophosphorous acid, the bulk passing on to the state of phosphoric acid. He then gives a detailed account of the combinations of hypophosphorous acid with soda, potassa, ammonia, baryta, and lime. He adds that, as there seems to exist only one combination of hypophosphorous acid and lime, it will be possible to titrate neutral solutions of lime with neutral hypophosphite of soda, using reddened tincture of litmus as indicator, since an alkaline reaction must appear when the precipitation is complete. The process may be extended to the salts of lead and other metals.

Material for Standard Weights and Measures.—F. Mohr.—As material for weights the author proposes glass containing a large proportion of silica. He remarks that the only men of science who work with good balances and accurate weights are the chemists; and hitherto none of them has considered it necessary in his weighing operations to consult the barometer and the thermometer, except as regards the gases. In one and the same set of weights are to be found pieces of brass and of platinum, and the same weights are used in Munich, at the height of 1700 feet, and in London, Kiel, and Greifswalde, at slight elevations above the sea-level. Against the consequences of these fallacies the best weights are no protection, and we may say that this source of error has been neglected in all chemical discoveries. We must easily see that it is unjustifiable to weigh finer than to milligrammes in all cases where a platinum crucible is concerned, or the ash of a filter, or glass vessels holding a considerable volume of air, or precipitates not absolutely insoluble.

Rarely is the substance weighed which we are in search of, as silica or alumina, but it is generally calculated from some compound, and this introduces the further uncertainty of the atomic weights which are brought to a round number, as in case of phosphorus, sodium, calcium, magnesium, &c. It may be said that the whole structure of organic chemistry has been erected with a false atomic weight for carbon, which is even yet uncertain. A fall of the barometer of 10 m.m., which may occur in one day, will render a kilo. weight of rock crystal lighter by 5·3 m.grms. What is the use, therefore, of adjusting a standard kilo. to the decimal of a milligramme if the barometer and the thermometer can bring about such changes? Weights of crystal and of platinum are not commensurable unless the atmospheric pressure is taken into account. (See "Researches on the Atomic Weight of Thallium," by the Editor, as an instance of a chemical investigation where the influence of the barometric pressure was taken into account in the operation of weighing.)

On Vanillo-diacetonamin.—W. Heintz.—The author describes this base, and its oxalate, sulphate, nitrate, and hydrochlorate.

On a New Organic Base in Animal Organisms.—P. Schreiner.—The base in question, which occurs in various parts of the animal system, both in a morbid and in a normal condition, evolves ammonia on treatment with soda; with chloride of zinc it gives a white flocculent precipitate soluble in hydrochloric acid. With auric chloride it yields an immediate gold-coloured precipitate which gradually becomes crystalline. With solution of tannin there is formed a white flocculent precipitate; with silver nitrate a white flocculent precipitate, soluble in ammonia, and in the nitric, sulphuric, and acetic acids. Iodide of potassium produces no change, and plumbic acetate, whether neutral or basic, occasions no precipitation.

Action of Ammonia upon Isatin (Second Treatise).—Dr. Erwin v. Sommaruga.—The author describes the derivatives of diamido-isatin; its reduction with sodium-amalgam: the salts of dihydro-mono-amido-isatin; the reduction of diamido-isatin with tin and hydrochloric acid; the derivatives of oxydiimido-diamido-isatin, its nitroso-product and its reduction; the oxidation of diamido-hydrindinic acid; for which compounds he in conclusion proposes a set of structural formulæ.

Constituents of Corallin, and their Relations to the Colouring-matters of the Rosanilin Group.—Carl Zulkowsky.—The author describes the following process as the most advantageous for the preparation of corallin:—One part of phenol is weighed into a flask, and ½ part sulphuric acid added by degrees. The mixture is heated for ten hours in the water-bath, in order to complete as fully as possible the formation of sulpho-phenol. The pulverised oxalic acid is dehydrated in a pan heated by steam, and 0·7 part added at once to the above mixture. The flask is fitted with a reflux-condenser and a thermometer, placed upon an iron disk, and gradually heated to 120°, when the oxalic acid is gradually dissolved. The temperature is maintained at from 125° to 130°, till the liberation of gas becomes decidedly slight and the contents of the flask on cooling appear as a thick dark mass. It is heated again and poured into an excess of water, which is constantly stirred, when the corallin is deposited as a resinous body of metallic lustre. The liquid contains a considerable quantity of phenol, sulpho-phenol, the whole of the sulphuric acid, and a little corallin, and is therefore drawn off for future utilisation. The deposit of corallin is repeatedly boiled in water by means of steam, when all adhering phenol is dissolved or evaporated. It is finally obtained as a solid, brittle, green mass. The yield of this process is 70 per cent. From the residues it is still possible to obtain a very considerable quantity of corallin. They are mixed with an excess of cream of lime, when the mass takes a deep red colour. The sulphate of lime is removed by filtration and the liquid concentrated, filtering off any further deposits of gypsum. The liquid is then further concentrated until the temperature reaches 135°. Such residues yield corallin if mixed with the corresponding quantity of anhydrous oxalic acid and treated as above specified. The author resolves rosolic acid into five portions: a rosolic acid crystallising in needles of a bright green metallic lustre, accompanied by violet-blue needles; a rosolic acid in larger garnet-red crystals, also accompanied by the violet-blue substance; a compound which appears as a light red crystalline powder contaminated with a little resin. The first-mentioned rosolic acid has a chemical composition expressed by the formula $C_{20}H_{16}O_3+H_2O$. Several isomeric compounds of this kind are probable. The garnet-red rosolic acid appears to have the composition $C_{19}H_{14}O_3$. The blue-violet acicular crystals, $C_{21}H_{16}O_6$, undergo a partial decomposition even at 100°. They are probably a derivative of the garnet-red acid, both yielding the same leuco-product. Leuco-rosolic acid has not been closely examined. Nor has the composition of the resinous matter (pseudo-rosolic acid) been determined. Its oxidation-product, obtained by treatment with a mixture of permanganate of potassa and caustic alkali, is a true colouring-matter, dyeing yellowish orange shades on wool closely resembling those produced with annatto. Its properties agree closely with those ascribed by Baeyer to the compounds of phthalidein with the phenols. Its elementary analysis agrees with the composition $C_{20}H_{14}O_4$.

MISCELLANEOUS.

The Royal Society.—The following are the awards of medals by the Council of the Royal Society for the present year:—The Copley Medal to M. Jean Baptiste Boussingault, for his long-continued and important researches and discoveries in agricultural chemistry; a Royal Medal to Mr. John Allan Broun, F.R.S., for his investigations during thirty-five years in magnetism and meteorology, and for his improvement in methods of observation; a Royal Medal to Dr. Albert Günther, F.R.S., for his numerous and valuable contributions to zoology and anatomy of fishes and reptiles; the Rumford Medal to M. Alfred Cornu, for his various optical researches, and especially for his recent re-dermination of the velocity of propagation of light; the Davy Medal to Messrs. Louis Paul Cailletet and Raoul Pictet, for their researches, conducted independently, but contemporaneously, on the condensation of the so-called permanent gases.

NOTES AND QUERIES.

Resorcin and its Derivatives.—Can anybody give me the address of the manufacturers of the above, or of their agents in London?—Charles H. Piesse.

Porion Evaporator.—Can anyone supply the date and number of the Specification of Patent, or say where will be found a description of the evaporator.—J. C.

Testing and Valuation of Gas Liquors.—(Reply to "Sul. Am.") In my paper on "Testing and Valuation of Gas Liquor," what I mean by normal sulphuric acid is sulphuric acid made of such a strength that 1 c.c. of it will exactly neutralise 0·017 grm. of NH_3. Such an acid contains 40 grms. of SO_3 per litre, or 0·04 grm. per c.c. Normal soda is a solution of caustic soda of such a strength that 1 c.c. will exactly neutralise 1 c.c. of normal sulphuric acid.—T. H. D.

Chemical Bronzes.—I believe that it is an admitted fact that the various manufacturing nations of Europe, also the Americans, are daily driving us closer into a corner (commercially); and, I think, in no trade more than in the various brass manufactures. We are (employers and employed) behind the age in chemistry: in bronzing, for instance, the French stand pre-eminently over us. I have no doubt but that some of the readers of the Chemical News could and would help us considerably in this matter. What is wanted is this—some plainly described processes to get the different colours on brass, spelter, and iron. If such recipes were given in the Chemical News they would be copied in *all* technical and many other newspapers.—Richard Bentley.

TO CORRESPONDENTS.

Burnard, Lack, and Alger.—This firm write to say that they were awarded two Silver Medals for their exhibits at the Paris Exhibition in addition to the "Honourable Mention" in our list of Oct. 25.

THE CHEMICAL NEWS.

VOL. XXXVIII. No. 991.

ON THE CONSTITUTION OF MATTER IN THE GASEOUS STATE.*

LADIES AND GENTLEMEN,—I esteem it a great honour to address you within these walls, about which there still hovers the ever fresh memory of him whose name we celebrate to-day, while we deplore his loss. I am fully sensible both of the great value of this honour and of the danger that attends it, and I have need to shelter myself under the authority of the great name of FARADAY. I have, therefore, chosen a subject connected with his earliest discoveries. The constitution of matter is a question of the highest importance with regard both to physics and to chemistry.

The word *gas* was introduced into science by Van Helmont, who, at the beginning of the seventeenth century, first pointed out, with some degree of precision, the differences existing between certain aëriform fluids. He it was who first spoke of *Gas silvestre*, formed by the combustion of charcoal, and given off during the fermentation of beer. To him, also, we owe the distinction—which kept its ground for two centuries—between gases and vapours. He regarded gases as aëriform fluids, incapable of reduction to the liquid state by cooling, whereas vapours require the aid of heat to maintain them in the gaseous state. An important difference of constitution seemed, therefore, to exist between these two kinds of aëriform fluid. This difference, however, is not fundamental, and the distinction between gases and vapours has disappeared, in a theoretical point of view, being, in fact, reduced to a simple question of temperature and pressure.

On March 13, 1823, Faraday, then a young man engaged as chemical assistant at the Royal Institution, read before the Royal Society a note entitled "On Fluid Chlorine." He had succeeded in condensing this gas to a liquid by a process which has become classical. This process consists in heating in a closed vessel placed in a water-bath crystals of chlorine hydrate. This compound, very rich in chlorine, is resolved at a gentle heat into chlorine and liquid water, the quantity of which is not sufficient to dissolve the whole of the chlorine. The latter is therefore disengaged in great part in the state of gas, which accumulates in the small space remaining to it, and is liquefied by the pressure which it exerts upon itself.

On the same day Sir Humphry Davy read a note "On the Liquefaction of Hydrochloric Acid Gas," which he effected by decomposing sal-ammoniac with sulphuric acid in a closed vessel. These researches were completed by Faraday, who, on April 10 of the same year, described the liquefaction of a large number of gases, directing his efforts, by Davy's advice, chiefly to those which are dense, or very soluble in water, such as sulphurous acid, ammonia, sulphuretted hydrogen, carbonic acid, and protoxide of nitrogen.

To enumerate the special processes adopted in each particular case would occupy too much time. We shall therefore merely observe that the chief, if not the only, means of condensation adopted in these experiments was compression, that is to say, the reduction of the gas to a small volume, and that this compression was exerted by the gas upon itself, as it accumulated in the very strong sealed glass tubes in which it was disengaged. Sir Humphry Davy, in the note above cited, had remarked that pressure appeared to be a more efficacious method of condensation than cooling, inasmuch as a double pressure reduces the volume of the gas to one-half, whereas a depression of temperature of 1° F. reduces the volume by only $\frac{1}{480}$, the lowering of temperature, moreover, soon attaining an impassable limit. It must, however, be especially observed that, even in his first experiments, Faraday made use of differences of temperature, if not to liquefy the gases, at all events to distil and isolate the liquids. Thus it was in the case of chlorine, for example, and in that of ammonia, which he liquefied by heating ammoniacal silver chloride in a bent tube sealed at both ends, the liquid ammonia then distilling over and collecting in the empty branch of the tube, which was cooled to a low temperature.

Similar phenomena will be exhibited in the experiment which I am about to show you, consisting in the liquefaction of cyanogen gas by heating cyanide of mercury in a small glass tube terminated by a long capillary tube bent in the form of the letter U. The figure of this curved portion will be projected on a screen by the electric light, and in a few seconds you will see the liquid cyanogen collect in the bend.

Before leaving this part of my subject, I would recall to your attention two of Faraday's discoveries resulting from the application of the principles just explained. Having compressed coal-gas to twenty-five atmospheres, Faraday, in 1825, discovered two important bodies, namely, butylene, a compound of great importance in a theoretical point of view—and benzene—so named by Mitscherlich several years afterwards—which in our own time has become the object of numerous and important applications, and the pivot of an entire department of chemistry.

Another instance is afforded by sulphurous acid gas (SO_2), which was liquefied by Bussy in 1824, at the ordinary atmospheric pressure by the effect of a cold of 12° to 15° below zero.

Whether we condense gases by pressure or reduce them to the liquid state by diminution of temperature, the result of either method is to bring their particles closer together. It would seem then, in accordance with Davy's view, that pressure ought to be more efficacious, as a means of condensation, than cooling. Nevertheless it is not so. The mere approximation of the particles of certain gases does not suffice to effect their liquefaction, and, moreover, the distances between the particles cannot be diminished indefinitely by pressure alone. M. Natterer, of Vienna, has compressed oxygen, hydrogen, and nitrogen to 3000 atmospheres without effecting their liquefaction. These gases, hitherto called permanent, cannot be liquefied by pressure alone, and their liquefaction, which has quite recently been effected, is the joint effect of strong pressure and a great degree of cold. This is the important point, and I request your permission to offer in this place a few explanations which will serve to place it in its true light.

The impossibility of liquefying certain gases by pressure alone is in accordance with the ideas which are current at the present day respecting the nature of aëriform fluids, and likewise with a discovery made in England within the last few years, on the continuity of the gaseous and liquid states. I will explain myself briefly on these two points.

Daniel Bernouilli first enunciated the idea that gases are formed of material particles, free in space, and animated by very rapid rectilinear movements, and that the tension of elastic fluids results from the shock of their particles against the sides of the containing vessels. Such is the origin of the kinetic theory of gases, which has been revived since 1824 by Herapath, Joule, and Krönig, and developed chiefly by Clausius and Clerk-Maxwell.

The law of Boyle and of Mariotte follows as a natural consequence of this idea. Suppose a gas occupying a certain volume, and composed of a definite number of material particles—or molecules so-called—to be contained in a closed vessel, such as the cylinder of an air-pump;

* The Faraday Lecture, delivered before the Fellows of the Chemical Society, in the Theatre of the Royal Institution, on Tuesday, November 12, 1878, by Ad. Wurtz, Membre de l'Institut; Doyen Ordinaire de la Faculté de Médecine de Paris.

the pressure on the piston will be determined by the number of shocks of the molecules diffused through the neighbouring stratum of gas. If, then, the volume of the gas be reduced, the number of particles in this layer will be increased, as well as the sum of the shocks, and the pressure will be increased in proportion thereto.

The velocities with which these molecules move are enormous. Clausius supposes that the molecules of air move with a mean velocity of 485 metres per second, and those of hydrogen with a mean velocity of 1844 metres per second. I say mean velocity, for all the particles of a gas do not move at the same rate. But can the particles traverse freely these wide spaces? By no means; their number is so immense that at every instant they enter into collision with one another, and rebound in such a manner that their motion is altered both in velocity and in direction. It follows, therefore, that the molecules of a gaseous mass are continually moving in all directions with variable velocities, their motion in the intervals of collisions being sensibly rectilinear. The distribution of the velocities has been made the subject of important researches by Clerk-Maxwell.

These movements of gaseous molecules determine a very important physical condition, namely, temperature. In fact, the energy of the rectilinear movements, that is to say, the mass of the gaseous molecules multiplied by the square of the velocity, gives the measure of the temperature, which consequently increases proportionally to the energy of the rectilinear movement, or, for the same gas—since the masses remain constant—it increases as the square of the velocity. If the velocity were reduced to nothing, the calorific motion would be annihilated, that is to say, the gas would be entirely deprived of heat. This state corresponds with the absolute zero.

The gaseous molecules moving in all directions, and coming into collision with one another in space, are very nearly emancipated from cohesion. Nevertheless this attractive force makes itself felt for the infinitely short time during which the molecules actually touch one another, or are on the point of doing so. This influence of cohesion is one of the causes of deviation from the law of Boyle or of Mariotte.

In liquids the influence of cohesion is manifest, preventing the molecules from separating, though it allows them to glide one over the other. This molecular cohesion, or attraction, is in continual strife with the force of expansion, or kinetic energy, which, if unopposed, would launch the molecules into space.

To understand the antagonism between these two forces, consider for a moment a saturated vapour in contact with the liquid from which it has been formed. When it is reduced to a smaller volume, a certain number of its molecules are brought within the sphere of action of cohesion; they are consequently aggregated together and precipitated in the liquid state, while the rest, being now diffused through a wider space, continue to move with the same velocity and to exert the same pressure as before. In this case the force of cohesion of the liquid particles exactly balances the expansive force or kinetic energy, and serves to a certain extent as a measure of its amount.

Now let the vapour be heated, after it has been withdrawn from the action of the liquid; its expansive force will then increase; it will dilate, and may then be compressed, until, by the approximation of its particles, it is again brought within the sphere of action of the cohesive force,—that is to say, to the point of saturation corresponding with the temperature to which it has been raised. With the increase of temperature, the expansive force or kinetic energy of the vapour likewise increases, whereas the cohesion of the liquid becomes less: hence the necessity of further diminishing the distances between the particles by increase of pressure. But this double effect of increased kinetic energy of the gaseous molecules, and diminished cohesion of the liquid molecules, going on progressively as the temperature rises, a point will at length be attained at which the energy of the molecular movement will finally gain the victory over the force of cohesion, *whatever be the pressure to which the vapour is subjected*. The minimum temperature at which this effect is produced, and at which, therefore, a vapour can no longer co-exist with its liquid under any pressure whatever, has been called, by my friend Dr. Andrews, the critical point, and by M. Mendelejeff the absolute boiling-point. Above this temperature, whatever may be the pressure, the gas, whether dilated or compressed, will maintain the same physical state, characterised by freedom of molecular or calorific movement.

I can show you by experiment this peculiar phenomenon of the sudden passage of a liquid mass to the state of gas, by heating liquid carbonic acid in a closed vessel, just as Cagniard de Latour formerly heated ether. Here is a tube, half filled with liquid carbonic acid, which we are about to immerse in water at 35°: you observe that the liquid first rises quickly in the tube, its coefficient of expansion being greater than that of gases; at the same time the meniscus flattens more and more, indicating a diminution of cohesion in the liquid (Andrews), and finally disappears altogether; in fact the liquid itself has disappeared, having been entirely and suddenly transformed into gas. What now must we do to cause it to reappear? We must lower the temperature, so as to diminish the kinetic energy of the gas, and increase the cohesion of the liquid. A moment will then arrive when the cohesive force will again be able to resume the contest, and the liquid will be re-constituted.

We are now in a position to understand why certain gases, hitherto called *permanent*, cannot be liquefied except by the combined action of very strong pressure and a very great degree of cold. The critical points of these gases are situated at very low temperatures. They have quite recently been liquefied, this great discovery having been made by MM. Cailletet and Raoul Pictet.

The principle of Cailletet's apparatus is the following:—The gas to be liquefied is introduced into a cylindrical glass vessel, and transferred by means of mercury to a a very strong glass tube sealed into the reservoir. This latter is firmly fixed in a cylindrical cavity hollowed out of a block of iron, and serving as a kind of closed mercurial trough. The cylindrical cavity communicates with a hydraulic press which injects water on to the surface of the mercury, driving it into the gas reservoir, which is ultimately quite filled with that liquid, the gas being thereby driven into the tube, where it is liquefied.

In this manner we shall be able by a few strokes of the piston of the hydraulic press to liquefy carbonic acid. Other gases less easily condensable may be liquefied in a similar manner, if the tube be cooled to −20° or −30°. But these temperatures do not suffice for the liquefaction of the so-called permanent gases. To cool these gases to lower temperatures, M. Cailletet avails himself of sudden expansion (*détente*). The gas, compressed to several hundreds of atmospheres, when allowed to expand suddenly, and drive the air before it, consumes a certain quantity of heat, and is thereby reduced to a kind of mist, which will appear on the screen, and pass away like a cloud, if we suddenly expand the strongly compressed carbonic acid gas, which we have here, in default of oxygen or hydrogen.

M. Raoul Pictet has succeeded in condensing oxygen and hydrogen in the form of liquids, properly so called, and even in obtaining the latter of these gases in the solid state. To produce this effect, he employs condensing apparatus of incomparable power, combining the action of a cold of 120°—140° below zero with that of enormous pressures amounting to 550 and even 650 atmospheres. The pressure is produced by the accumulation of the gases in a closed space consisting of a long copper tube of very thick metal. The oxygen was produced by heating potassium chlorate in a howitzer shell, having a copper tube soldered into its orifice. The hydrogen was prepared in a similar apparatus, by decom-

position of a dry mixture of potassium formate and potassium hydroxide.

To produce very low temperatures of 120° or even 140° below zero, M. Pictet resorts to a very ingenious artifice. Over the reservoir-tube which surrounds the copper tube, and in which these low temperatures are intended to be produced, he superposes another system of concentric tubes, intended to produce a first fall of temperature amounting to −65°, by the volatilisation of liquid sulphurous acid. By means of this first depression of temperature it has been found possible to liquefy carbonic acid gas in the inner tube of the system just mentioned, by a pressure of only a few atmospheres. The carbonic acid thus liquefied being introduced into the lower reservoir-tube of the apparatus, produces by its volatilisation, a second fall of temperature round the copper tube containing the compressed oxygen which is to be liquefied. M. Pictet has in fact established a double circulation, one of sulphurous acid, the other of carbonic acid. I will describe the former. Sulphurous acid gas is liquefied by a pressure of three atmospheres, and collects in a strong vessel, from which it passes through a tube into the upper reservoir. The pressure is exerted by means of a force-pump. A suction-pump connected with the force-pump, and acting in concert with it, withdraws the liquid sulphurous acid from the reservoir-tube, and transfers it to the force-pump, which brings it back to the vessel, and thence to the upper reservoir-tube.

The circulation of the carbonic acid is established in the same manner, by means of two pumps, one of which condenses the gas by forcing it into tubes cooled to −61°, while the other, which is a suction-pump, sends it back to the force-pump. The volatilisation of the carbonic acid produces round the copper tube, the low temperatures above mentioned. The copper tube is in fact surrounded by solid carbonic acid.

In this manner M. Pictet has liquefied oxygen, and has approximately calculated its density. He has also liquefied and even solidified hydrogen, which he has seen to issue from the tube in the form of a steel-blue liquid jet, which partly solidified. The solid hydrogen, in falling on the floor, produced the shrill noise of metallic hail, thus confirming the bold and ingenious idea of Faraday, who first suggested that hydrogen is a metal.

The experiments of MM. Raoul Pictet and Cailletet have, then, removed from science the distinction between permanent and condensable gases. Permanent gases exist no longer. All aëriform fluids may be liquefied with a facility greater in proportion as their critical points are situated at higher temperatures. From a physical point of view, therefore, gases and vapours have the same constitution, being formed of molecules which move freely in space. In what, then, do they differ? They differ by the nature and constitution of these molecules; and here we enter on the domain of CHEMISTRY.

It is supposed in chemistry that the molecules of each species of gas or vapour are formed of a definite number of atoms. The simplest molecules, like those of mercury vapour, are formed of single atoms. Others include several atoms of the same or of different kinds: and these latter molecules may be very complex, that is to say, formed of a large number of atoms held together by affinity, and vibrating in concert in a system to which they are attached, viz., the molecule. In this system, which has a definite form, extent, and centre of gravity, the molecules execute their own proper movements, and are at the same time carried forward with the entire system in the molecular paths.

I cannot here dilate on the nature and chemical properties of the several gases and vapours. I wish merely to throw light on a single point, which is of great importance, inasmuch as it constitutes one of the foundations of chemical science.

The proposition which I am about to enunciate is generally adopted by chemists, resting as it does on an imposing array of facts:—*Equal volumes of gases or vapours, under the same conditions of pressure and temperature, contain equal number of molecules.*

The Italian chemist, Amadeo Avogadro, in discussing the discoveries of Gay-Lussac respecting the simple relations which exist between the volumes in which gases combine, was the first to recognise that there likewise exists a simple relation between the volumes of gases and the number of molecules which they contain. The simplest hypothesis, said he, that can be made regarding this matter, consists in supposing that all gases contain in equal volumes equal numbers of "integrant molecules." By this term he denoted what we now call simply *molecules*, and he distinguished these integrant molecules from the "elementary molecules," which we call *atoms*. According to him, the integrant molecules of gases are all equally distant one from the other, and these distances are so great in proportion to the dimensions of the molecules that the mutual attraction between the latter is reduced to nothing.

These integrant molecules are composed of a greater or smaller number of elementary molecules, not only in compound, but likewise in simple bodies: the integrant molecules of chlorine, for example, are composed of four elementary molecules, and the same is the case with the integrant molecules of hydrogen. What happens, then, when chlorine and hydrogen combine together? The integrant molecules of these two bodies are then resolved into elementary molecules, which combine, two by two, to form hydrochloric acid.

Ideas analogous to those of the Italian chemist were enunciated in 1814 by Ampère, and thus there has been introduced into chemical science the notion that there exist two kinds of small particles, namely, molecules and atoms, the former being diffused in equal numbers through equal volumes of gases.

But this notion, so clearly enunciated more than sixty years ago, was afterwards destined to be obscured. Berzelius, taking up Ampère's proposition, altered it by substituting atoms for molecules, and saying that "equal volumes of gases contain equal numbers of atoms." This proposition, which has given rise to long discussions, must now be rejected, for it is inexact. It is to Gerhardt, and more recently to Cannizzaro, that is due the honour of having restored the thesis of Avogadro and Ampère, and pointed out its importance in connection with chemical theory. This I must explain in conclusion.

In the first place Gerhardt simplified the rule of Avogadro. The latter supposed that a molecule of chlorine or of hydrogen contains four atoms, whereas Gerhardt regards it as consisting of two. Avogadro's proposition thus modified, assumes a very simple form, and may be enunciated in the following terms:—Suppose that a volume, or the unit of volume, of hydrogen contains one atom, then the molecules of all gases and vapours will occupy two volumes. Thus, a molecule of hydrogen formed of two atoms will occupy two volumes, and a molecule of chlorine formed of two atoms will likewise occupy two volumes. What, now, will happen when chlorine combines with hydrogen? The molecules will be cut in two, and each of the two chlorine-atoms, uniting itself to an atom of hydrogen, two molecules of hydrochloric acid will be formed, each occupying two volumes. Thus, if an atom of hydrogen occupies one volume, a molecule of hydrochloric acid will occupy two volumes. The same is the case with the molecules of all other gases and vapours.

1 mol. water	formed of	2 at. H and 1 at. O	occupies	2 vols.
,, ammonia	,,	3 at. H and 1 at. N	,,	,,
,, marsh gas	,,	4 at. H and 1 at. C	,,	,,

This list might be prolonged by taking as examples a large number of gaseous or volatile bodies belonging both to mineral and to organic chemistry, and including chlorinated, brominated, and oxygenated compounds of the metalloids, and of a large number of metals. The countless volatile compounds of organic chemistry, hydrocarbons, alcohols, chlorides, bromides, organo-metallic

compounds, compound ammonias, aldehyds, ketones—all this legion of divers compounds—conform to the law of Avogadro and Ampère, their molecules occupying two volumes if an atom of hydrogen occupies one volume. Hence it follows that the relative weights of two volumes represent the relative weights of the molecules or the molecular weights. To find these latter, therefore, it is sufficient to double the numbers which express the weights of a single volume, or of the unit of volume, that is to say the densities. The densities of gases may be referred to that of hydrogen as unity, and the atomic weights to that of hydrogen. The unit being then the same, it follows that the numbers which express the double densities referred to hydrogen will also represent the molecular weights.

Chemists represent the constitution of molecules by formulæ, each of which shows the number of atoms condensed within the molecule. Now the molecular weights being known, it is very easy to deduce the formulæ from them, as these formulæ must represent the number of atoms comprised in two volumes. Such is the relation which exists between the Law of Volumes and Chemical Notation. The rule of Avogadro and Ampère has, in fact, become one of the bases of this notation. There are, however, certain exceptions to its generality, but they are probably more apparent than real. Sal-ammoniac, ammonium sulphydrate, phosphorus pentachloride, iodine trichloride, sulphuric acid, calomel, amylene hydrobromide, and chloral hydrate, have vapour densities such that their molecules appear to occupy four volumes. Such, however, is not the case; and it may be shown that the bodies in question do not volatilise without decomposition, but that, when they are heated, their molecules split up into two, each of which occupies two volumes. Being unable to analyse all the cases above-mentioned, I will confine myself to the last, viz., chloral hydrate, which has been given rise to a long discussion.

The question to be decided is, whether this compound is or is not decomposed by conversion into vapour. If it really suffers decomposition, it should be resolved into anhydrous chloral and water. That this decomposition really takes place may be shown on a method based on the theory of dissociation developed by M. H. Ste.-Claire Deville.

Here is the case in a few words. We have here in a tube a certain volume of the vapour of chloral hydrate under a certain pressure; it is required to show that this vapour contains vapour of water. For this purpose we are about to introduce into it a body capable of emitting vapour of water, crystallised potassium oxalate, for example. If the atmosphere is dry, this salt will give off vapour of water just as it would in dry air or in vapour of chloroform at the same temperature, and it will continue to emit this vapour until the atmosphere shall have taken up a degree of humidity corresponding with that which is designated by M. H. Ste.-Claire Deville as the *dissociation tension* of the hydrated salt in question. If, on the other hand, the chloral atmosphere is moist, and exhibits exactly the degree of humidity just defined, the crystallised oxalate will not emit any water. In this first tube, then, we have the vapour of chloral hydrate; the second contains vapour of chloroform. This latter is dry, and I am about to prove to you that the former is moist. In fact, the crystallised potassium oxalate which we are introducing into the chloroform tube will rapidly depress the level of the mercury by emitting vapour of water, whereas in the atmosphere of chloral hydrates it will not emit vapour of water, and consequently will not depress the level of the mercury. This shows that chloral hydrate undergoes decomposition when converted into vapour, and this supposed exception to the rule of Avogadro and Ampère vanishes, like all the rest, when submitted to the test of experiment. This rule appears, then, like a grand law of nature, as simple in its enunciation as it is important in its consequences.

Such are the considerations which I wished to lay before you on the physical and chemical constitution of gases. Does not this exposition seem to show that, of all the states which matter can assume, the gaseous state is the most accessible to our researches, and the best known—not, indeed, that we can affirm the certainty of the theoretical considerations which I have brought before you, for they are but probable. In the physical sciences nothing is certain but well-observed facts and their immediate consequences, and, whenever we attempt to make these facts the basis of any general theory, hypothetical data are apt to mix themselves up with our deductions. In the present case the hypothesis consists in assuming that gases and matter in general are formed of molecules, and these latter of atoms. No one has ever seen these molecules and atoms, and it is certain that nobody ever will see them. Does it follow, then, that we ought to reject or disdain this hypothesis? By no means. Our theories may be verified in their consequences, and may thereby acquire a certain degree of probability. The theory under consideration has been subjected to this ordeal, and nothing has hitherto been found to contradict it. Yes, it is probable that gases are composed of small particles moving freely in space, with immense velocities, and capable of communicating their motion by collision or by friction. It is probable that these molecules are diffused in space in numbers so enormous that the most rarefied spaces still contain legions of them; and it is this circumstance which explains the possibility of the movements of the radiometer.

Be this as it may, the idea of Daniel Bernouilli has been developed into a beautiful theory—the kinetic theory of gases—a theory which has shed a sudden clearness, an unexpected light, on matters which seemed to be veiled in the deepest obscurity. The molecules, as already stated, are invisible. Nevertheless, attempts have been made to penetrate this invisible world by the force of scientific reasoning, and by an effort which does honour to the human mind, even if it be destined to remain barren. The illustrious authors of the kinetic theory of gases have sought to determine, not only the velocities of the gaseous molecules, and the prodigious number of their collisions during a unit of time, but likewise their distances, their absolute dimensions, and their number in a given volume. And here we arrive at results which bewilder the imagination, but which, in this lecture, I must not attempt to unfold.

Permit me only to add that these great labours mark a resting-place in our course, and are, perhaps, an approach towards the solution of the eternal problem of the constitution of matter—a problem which dates from the earliest ages of civilisation, and though discussed by all the great thinkers of ancient, as well as of modern, times, still remains unsolved. May we not hope that in our own time this problem has been more clearly stated and more earnestly attacked, and that the labours of the nineteenth century have advanced the human mind in these arduous paths, more than those of a Lucretius, or even of a Descartes and a Newton. From this point of view, the discoveries of modern chemistry, so well expressed and summarised by the immortal conception of Dalton, will mark an epoch in the progress of the human mind; and to one of the most important among these discoveries—that of the liquefaction of the gases—grateful posterity will for ever join the glorious name of FARADAY.

On Isodulcite.—L. Berend.—It has been recently shown, by MM. Liebermann and Hörmann, that the glycoside of Persian berries when decomposed by acids, contrary to previous statements, yields a well-crystallised sugar, very similar to the isodulcite prepared by Hlasiwetz and Pfaundler from quercitrin. The author finds that some of the statements of the two latter chemists are somewhat inaccurate, and that the two sugars are identical.—*Berichte der Deutschen.*

ANALYSIS OF A REMARKABLE MINERAL WATER.

By OTTO HEHNER, F.C.S., F. Inst. Chem.

I have recently had to analyse a sample of mineral water, stated to have been taken from a spring about 20 miles from Cape Town, and as the results of the analysis are somewhat extraordinary I subjoin them below.

The water was of a brown colour, resembling that of dark ale, had a specific gravity of 1020·5 at 15·5° C., and was intensely acid, both to the tongue and to test paper. 100,000 parts contained:—

HCl (free)	9·30
N_2O_5 (free)	0·64
P_2O_5 (free)	14·58
SO_3 (free)	31·21
$FeSO_4$	1029·46
$Fe_2(SO_4)_3$	218·20
$Al_2(SO_4)_3$	525·19
$CaSO_4$	100·74
$MgSO_4$	188·37
$(NH_4)_2SO_4$	28·20
K_2SO_4	2·29
Na_2SO_4	7·24
	2155·42
Total Fe	440·38

I was told that the spring was far removed from any possible source of organic or other contamination.

54, Holborn Viaduct.

OZONE AND THE ATMOSPHERE.*

By ALBERT R. LEEDS Ph.D.

(Continued from p. 236.)

Critical Examination of Ozonoscopes.

Potassium Iodide.—As the potassium iodide manufactured in this country, and sold for chemically pure, has presumably been employed in the preparation of ozone tests by American observers, it was important to examine into its purity. The principal manufacturers are four in number, and their goods were examined with the following results:—

Analyses of C. P. Potassium Iodide Manufactured in the United States.

Samp.	Reaction.	Carbntes.	Sulphates.	Chlorides.	Iodates.	Iodine.
1	Alkaline	Absent	Absent	Absent	Absent	Absent
2	,,	Present	Present	,,	,,	Present
3	,,	Absent	Absent	,,	,,	Absent
4	Neutral	,,	,,	Present	,,	,,

It will be seen from this table, that of the goods purchased at the time the analyses were made, those of but one manufacturer were free from foreign salts, and had a neutral reaction; and, as nothing is easier than the introduction of minute amounts of impurities into chemicals manufactured on the large scale, the necessity of analysing each sample of potassium iodide employed in the making of ozonoscopes is evident.

In order that no unnecessary element of uncertainty, however, should be introduced into the comparison of the various ozone tests employed in this investigation, the potassium iodide was especially made for the purpose. The following method was found convenient, and yielded excellent results:—

36 grms. of iodine were introduced into a flat-bottomed half-litre flask, with 250 c.c. water, and then 12 grms. of clean pianoforte wire added in successive portions. The action at first was slow, but increased with the liberation of heat due to chemical combination, and at the close was accelerated by heating on a water-bath until all brown colour had disappeared. To the filtrate, which was of a greenish colour, 12 grms. of iodine were added. Potassium carbonate, prepared by ignition of potassium bitartrate, was added, to decided alkaline reaction, and the flask heated on a water-bath until the precipitate separated in the form of ferrosoferric hydrate. This precipitate, after filtering, was evaporated to dryness, and washed out carefully to obtain the last portion of potassium iodide. The filtrates were evaporated, and two portions of crystals, amounting to 13·5 grms. and 11 grms., of pure potassium iodide obtained from them. The mother-liquor was then evaporated to dryness, alcohol of 85 per cent added to dissolve out the iodide and get rid of excess of potassium carbonate, the potassium iodide crystallised from the alcoholic solution, and washed with absolute alcohol, yielding 29·5 grms. of the salt. The total yield was 54 grms. instead of 62, the theoretical amount.

Starch.—In order not to spend time unnecessarily in the examination of starches from various sources, a skilful pharmaceutist furnished me with arrowroot starch, which he had assured himself by microscopic examination contained no substances of organic origin other than the starch granules. This was washed with large excess of cold distilled water until the filtrates afforded no trace of saline matters, and then dried at the temperature of the air.

Paper.—A great variety of papers was examined, and all rejected for one reason or another, except the best Swedish filter-paper. This appeared to have no action on the tests, except possibly upon the thallium and the Moffat. The former, after keeping for some time, was minutely spotted with thallic oxide, and the latter turned brown on the edges. But it is probable that, in the latter case at least, the alteration of the ozonoscope was due to other causes than the paper. The paper might have been treated with dilute acid, and then repeatedly washed with distilled water, in order to remove all the impurities soluble in these menstrua; but this was not done for fear that the paper might be made too fragile to stand much subsequent handling. But fine cotton cloth, treated in this manner, might answer for certain of the tests better than paper.

Classification of Ozonoscopes.—The most important ozonoscopes hitherto in use may be conveniently grouped into five classes:—

I. Those depending on the decomposition of a metallic iodide, the liberated iodine indicating the reaction. Under this head the substance almost exclusively used is iodide of potassium. An examination of the tables given below will show that it is the most sensitive of all the ozonoscopes examined. Unfortunately, the action of ozone does not stop with oxidation of the potassium, but extends to the iodine; so that a paper once brown from free iodine may become quite colourless again from the formation of potassium iodate. It is proposed to examine other haloid compounds, especially the iodides of the heavy metals.

II. Class No. I., with starch added as an indicator. Very many tests included in this class have been proposed. They differ chiefly in the relative proportions of potassium iodide and starch. With some the comparison is made when dry, in others after moistening. Or the paper may contain potassium iodide only, the iodide of starch being formed subsequently, by moistening the papers, after exposure, with starch solution. We have added to this list one new test, containing iodide of cadmium (as representative of the iodides of the heavy metals) and starch. It develops the characteristic blue colour of iodide of starch very strongly and persistently on moistening, but is less sensitive than some of the other tests.

III. Those depending upon the alkaline reaction resulting from conversion of the electro-positive element into the form of oxide, litmus or some similar colouring matter being added as indicator. It will be seen from experiments detailed below that there are other bodies sometimes present in the atmosphere which decompose potas-

sium iodide as well as ozone. But if this decomposition is attended with formation of caustic potash only when ozone is the decomposing agent, the litmus-paper will be turned blue only in case of the presence of ozone. This was the ground taken by Houzeau, who proposed, and has strenuously advocated, tests of this character. He admits, however, that hydrogen peroxide will likewise develop an alkaline reaction. The tables above referred to exhibit a similar result.

The best method of preparing these tests is to saturate papers with litmus solution containing about 1 centigrm. of litmus in 1 c.c. The litmus must be brought with great care to that shade of wine-red at which it is most sensitive. After drying, some of these papers are impregnated with a 1 per cent solution of potassium iodide, and again dried. Papers of both kinds, the plain and iodised litmus, are cut into slips and exposed in pairs. It is expedient to subject these tests to the action of artificially prepared ozone to see that they are really sensitive. Great differences were found in this manner, between tests not apparently differing much in colour. Even the best did not appear so sensitive as some of those in the first and second classes. (See tables.)

Two new tests were added to this class—the alizarin and phenol-phthalein potassium iodide tests distinguished by the use of alizarin or phenol-phthalein in place of litmus. The alizarin was prepared by dissolving the crystals sublimed from commercial alizarin in 80 per cent alcohol.

Papers impregnated with this solution were dried, moistened with a 1 per cent potassium iodide solution, and dried again. The latter were exposed in strips along with non-iodised alizarin papers. The phenol-phthalein was made by heating 3·3 grms. sublimed phthalic anhydride with 6·6 grms. phenol and 1·5 grms. sulphuric acid at 120° to 130° C., for three hours, thoroughly washing the brown resin obtained, which amounted to about 3 grms.,* and dissolving in alcohol.

The phenol-phthalein potassium iodide tests were prepared in a manner similar to those of alizarin. It was found, however, that neither of these tests, especially the phenol-phthalein, was as sensitive as that made with properly prepared litmus, and their use, after some trials, was therefore abandoned.

IV. Those depending upon the oxidation of a metal or metallic compound, with the development of a corresponding change of colour.

The most important ozonoscopes in this class which have previously been studied are silver, thallous hydrate, manganous sulphate, and plumbic sulphide. Silver-leaf immersed in an atmosphere containing a sufficient percentage of ozone is very slowly affected, if at all, except in the presence of moisture. Under these circumstances its surface is energetically oxidised, with the formation of magnificent yellow, blue, and other films, passing into black at those points at which the formation of argentic oxide has reached a maximum.

Unfortunately, silver is not sufficiently sensitive to ozone. In a vessel containing in every litre of oxygen 1 m.grm. of ozone, the potassium iodide, the iodo-starch tests, the thallous oxide, Houzeau's, and some other tests were affected before a notable change had occurred upon a moistened silver surface.† It is stated by Houzeau that when a litre of oxygen containing about 1 centigrm. of ozone was passed over silver, blackening took place, but when the same amount of ozone was diluted with 50 litres of oxygen the silver was unaffected.‡ Even the latter mixture contains a far larger amount of ozone than is ordinarily present in the atmosphere, if we accept the determinations of Pless and Pierre,‖ who found, by titration of the iodine set free on the surface of potassium iodide paper, that 255 litres of air contained but 0·02 m.grm. ozone. Zenger found in 100 litres of air from 0·002 to 0·01 m.grm. ozone.*

For the present, at least, silver is inapplicable as an atmospheric ozonoscope, not from want of reliability, but from lack of sensitiveness; and the desideratum is to find some ozonoscope which will be similar to silver in its reactions towards the compounds of the atmosphere, and at the same time of adequate sensibility.

The next most important reagent of this class is thallous hydrate.† Small bars of metallic thallium were dissolved in dilute sulphuric acid, the reaction being hastened by the introduction of strips of platinum foil, and thallous sulphate crystallised out in brilliant prismatic needles. A solution of this salt was exactly neutralised with baryta, the filtrate from the barytic sulphate containing 10 per cent of thallous hydrate. Strips of filtering-paper, immersed in this filtrate, were dried over caustic potash under a bell-jar, so as to prevent them as far as possible from absorbing carbonic anhydride from the air.

When the ozonoscopes are compared dry thallous hydrate occupies a very high position, sometimes the fourth or third place, but usually the second position. After moistening, the papers of the first three classes exhibit a more striking appearance than the thallium peroxide. This result differs from that obtained by Huizinga, who thought that the thallous hydrate was more sensitive than the iodo-starch tests, when the papers were *freshly* prepared and the solution sufficiently concentrated.‡

On examining into the behaviour of thallous hydrate, when exposed to the disturbing influences of the other bodies which may be present in the atmosphere, we found that it was unaffected by nitrous acid, if we accept one trial in which the paper turned yellow. This was apparently due to some other cause than the formation of peroxide, which is of a brown colour. This confirms the result previously arrived at by Böttger.‖

In an atmosphere containing hydrogen peroxide the thallous hydrate remained white, or if immersed, after having been turned brown by ozone, was bleached. Carbonic anhydride is rapidly absorbed by thallous hydrate, carbonate being formed, which is not decomposed with formation of peroxide in presence of ozone. Thallous hydrate is therefore not applicable to the detection of ozone in the atmosphere, though in the laboratory, to detect ozone in the presence of nitrous acid, it is of great service.§

Manganous sulphate is altogether inapplicable as an atmospheric ozonoscope, whether dry or moist: in the former condition it was scarcely affected at all, in the latter it occupied one of the lowest places in the scale. That there might be no error, from want of care in the preparation of the salt, the re-crystallised sulphate was precipitated from its solution in alcohol, and used in making the tests. Thinking that the manganous oxide might be more easily converted into peroxide, if it were in combination with a feeble acid like acetic, some manganous acetate was prepared from the former salt by conversion into carbonate and then into acetate. Tests prepared with this salt did not appear more sensitive than those with manganous sulphate. They had the further disadvantage of being powerfully affected in a dilute atmosphere of nitrous acid, turning dirty brown, whilst the sulphate was little changed. They likewise became light brown in an atmosphere containing a trace of hydrogen peroxide. The manganous sulphate ozonoscopes contained 10 m.grms. of the salt in each square centimetre of surface. Of the manganous acetate papers, some were dipped in a concentrated, others in a more dilute solution, but the results obtained with each were identical.

Similar remarks apply to the plumbic sulphide papers, which were so prepared that each square centimetre of

* See Bayer, *Ber. der Deutsch. Chem. Gesell.*, 1871, p. 658.
† See also Fremy, *Comptes Rendus*, 61, 939.
‡ *Comptes Rendus*, December 18, 1865.
‖ *Jahresb. der Chemie*, 1857, 79.

* Zenger, *Wien. Akad. Ber.*, 24, 78.
† Böttger, *Journ. Prak. Chem.*, 95, 311.
‡ Huizinga, *Journ. Prakt. Chem.*, ci., 321.
‖ Böttger, *Journ. Prakt. Chem.*, 95, 311.
§ See Lamy, *Bull. Soc. Chim.*, [2], 11, 210; March, 1869.

surface contained about 10 m.grms. of the sulphide. They were not sensitive. Moreover, in an atmosphere of hydrogen peroxide or nitrous acid they were bleached.

V. Those depending upon the oxidation of organic bodies, with the development of a characteristic change of colour.

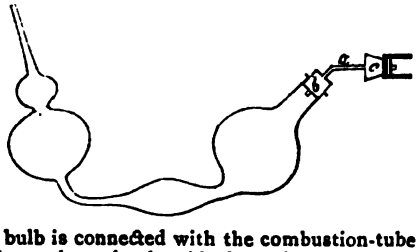
The only one of these substances particularly studied was the resin of guaiacum. It appeared essential to use this resin in the original masses, for if that which had been pulverised was used, even if it had not been exposed to light, the tincture made from it appeared deficient in sensitiveness. A tincture containing 8 per cent of the resin was prepared with 90 per cent alcohol. The papers so prepared had a slight yellow tinge. They were moderately sensitive, acquiring speedily when dry a faint blue colour, and when moistened occupying a position midway between the ozonoscopes most sensitive and those least so to the influence of ozone. They were rapidly turned greenish blue by nitrous acid, and bluish green by hydrogen peroxide. For these reasons, and on account of their deficient sensibility, they are objectionable as atmospheric ozonoscopes.*

(To be continued).

ON A NEW FORM OF NITROGEN BULB.

By H. H. B. SHEPHERD, F.C.S.

AGRICULTURAL and other chemists who have many nitrogen combustions to perform may find it useful to adopt the form of absorption-bulb shown in the following sketch:—



The bulb is connected with the combustion-tube by the bent glass tube, *a*, by the aid of a cork, *c*, and a caoutchouc stopper, *b*. This bulb, it will be seen, is a modification of the Will and Varrentrapp apparatus, but it possesses an advantage over the latter, inasmuch as it can more readily be charged with acid from a burette. It can also easily be provided with a new connecting tube, whereas the Will and Varrentrapp bulb is sometimes rendered useless by the fracture of this part occasioned by the heat of the furnace.

The Leighs, Charlton, S.E.

DETECTION AND APPROXIMATE DETERMINATION OF MINUTE QUANTITIES OF ALCOHOL.†

By J. C. THRESH, Pharmaceutical Chemist.

THAT the detection of small proportions of alcohol is a matter of some importance is evident to any one who looks through the Year-books issued by our Conference, no less than sixteen papers bearing on the problem being abstracted in the volumes already published. The analyst desires a test which will enable him to detect with absolute certainty the presence of alcohol in essential oils and other medicaments when mixed therewith, and the physiologist requires such a test to solve a number of problems relating to the action of alcohol upon the system and its presence or absence in the tissues and animal fluids. Hitherto no process has been published which is capable of giving certain results in such cases, either qualitative or quantitative.

Probably the best test as yet proposed is that of Lieben as modified by Hager (abs. *Y. B. P.*, 1871, 237), which depends upon the formation and deposition of crystals of iodoform, when solutions of iodine and potassium hydrate are added successively to the warmed fluid containing alcohol. This test is said to be capable of detecting 1 part in 2000 of water, but I have failed to obtain by it any decided reaction with so dilute a solution. Moreover, a number of other volatile and non-volatile compounds yield the same reaction under similar circumstances (*e.g.*, aldehyd, acetone, methyl alcohol, propyl alcohol, volatile oils, gum, sugar, lactic acid, &c.). Another general test is Hardy's (abs. *Y. B. P.*, 1872, 161), depending upon the production of a blue colour when guaiacum resin, hydrocyanic acid, and sulphate of copper are added to an aqueous solution of alcohol, but it is incapable of detecting less than 1 part in 150. In the same year-book (p. 160) is an abstract of a method proposed by M. Berthelot. Benzoic chloride is mixed with the suspected solution, the mixture warmed, and a little caustic potash added, when a characteristic odour of benzoic ether is evolved if alcohol be present. This test is very sensitive with a 4 or 5 per cent aqueous solution, but when smaller proportions are present, or the fluid contains other odorous substances, it is quite useless.

The old chromic acid test as hitherto applied is perhaps the most fallible of all, since innumerable substances give the same reaction, in virtue of their greed for oxygen. A more modern test is that proposed by Davy (abs. *Y. B. P.*, 1877, 109), and depends upon the production of a blue colouration when molybdic acid dissolved in sulphuric acid is added to the fluid containing alcohol, but Hager (abs. *Y. B. P.*, 1877, 285) failed entirely to obtain the reaction. Besides these general tests a great many others have been proposed for use in special cases, thus Böttger (abs. *Y. B. P.*, 1873, 164) recommends solid caustic potash for detecting alcohol in ether, and anhydrous glycerine for its detection in essential oils. Fuschin, tannin, aniline red, jalap resin, and many other substances have also been similarly employed, but scarcely one of the tests enumerated, it is worthy of mark, is capable of being employed to make even an approximate quantitative determination of the ethyl hydrate.

Some time ago, when examining a solution containing aldehyd, I was struck by the remarkable delicacy of the caustic potash reaction; I found that an aqueous solution containing one one-thousandth part of pure aldehyd when boiled with a fragment of solid caustic soda or potash, and allowed to stand for a little while, exhibited a distinct yellow colour. If a solution containing 0·5 per cent of aldehyd be thus treated, the liquid becomes deep yellow, and a flocculent yellow precipitate gradually subsides, and this solution when diluted first with a little alcohol and then with 50 volumes of water, still exhibits a yellow tint when examined in a long test-tube over a sheet of white paper or a porcelain slab.

I then commenced a series of experiments, having for their object the detection of minute quantities of alcohol by converting it into aldehyd, and treating the resulting solution with caustic alkali. After making a great number of attempts I succeeded in devising a method which is not only reliable as indicating with certainty the presence of alcohol, but which within certain limits gives fairly approximate quantitative results.

Distillation with sulphuric acid and permanganate of potash was first tried, and it was found that with a given proportion of permanganate a 0·1 per cent solution of alcohol could readily be detected, but with even a slight excess of permanganate the results were entirely negative.

* It is probable that the influence of light as well would be unfavourable to the employment of organic matters as ozonoscopes.

† From the *Pharmaceutical Journal*, November 9, 1878.

Other oxidising agents were then tried, and bichromate of potash found to be the most reliable, since an excess, unless large, did not materially decrease the yield of aldehyd. Still, the quantitative results obtained from the same solution varied very considerably, and for some time the cause was apparently inexplicable. At length, noticing that when the determinations were very low that considerable bumping took place during the distillation, several substances were added to obviate this, and it was found that when a few small pieces of pumice were placed in the flask the distillation proceeded evenly and the results were remarkably uniform. Fresh pumice must be used for each distillation. For an aqueous solution containing from 0·04 to 0·4 per cent of alcohol the following method may be relied upon for quantitative determinations, whilst it will detect with certainty 0·01 per cent, or 1 in 10,000. When the quantity of alcohol present differs much from the proportion here given the determination is too low, becoming more and more unreliable as the percentage rises above or falls below these limits.

The requisites are a saturated solution of bichromate of potash, a dilute sulphuric acid (B. P., acid and water, equal quantities), a syrupy solution of caustic soda, methylated spirit free from aldehyd, a 200 c.c. flask with good condensing arrangement attached, and a long narrow test-tube graduated to 3 and 23 c.c.

One hundred c.c. of the dilute alcohol are placed in the flask, 2 c.c. of bichromate solution, 8 c.c. of the dilute acid, and a few pieces of pumice are added and 20 c.c. distilled (not too rapidly), and the distillate conveyed by a long tube to the bottom of the test-tube in which has been previously placed 3 c.c. of the soda solution. The liquid in the tube is then heated, kept at the boiling-point for a few seconds, and placed aside for a couple of hours. If 0·1 per cent of alcohol was contained in the original solution the contents of the test-tube will be of a deep yellow colour and will have deposited flocks of aldehyd resin; with 0·05 per cent no resin is formed, but the fluid is deep yellow and perceptibly opalescent; with 0·01 per cent the colour is just perceptible, but the characteristic odour is still very distinct. To make a more accurate determination, dilute 1 part of pure aldehyd with 200 of water; to this add 30 parts of the caustic soda solution, and treat in the same way as the above distillate. After the lapse of two hours (the reaction not being complete for nearly this length of time) dilute with 200 parts of warm methylated spirit and add water to 500 parts. This solution is quite clear and of a reddish yellow colour, and will keep for some time, especially if not exposed to the light. Mix 5 c.c. of this solution with 45 c.c. of water in a glass such as is employed for Nesslerising, and take this as a standard solution. It does not keep more than two or three hours, hence fresh standards must be from time to time prepared, or a solution of bichromate of potash made of equal depth of colour (the tint being almost identical) and kept as a standard of reference. To make the quantitative determination, dilute the distillate with sufficient warm spirit to make a clear solution, and add water to 50 c.c. Upon ascertaining the quantity of this solution, which must be diluted with water to 50 c.c. to bring the depth of colour to that of the standard solution, the percentage of alcohol in the original solution is immediately known. The following are fair specimens of the results obtained.

Strength of Alcoholic Solution.	Strength Calculated from Result of Experiments.
0·02 per cent	0·012
0·10 ,,	0·089
0·10 ,,	0·100
0·10 ,,	0·088
0·10 ,,	0·092
0·20 ,,	0·166
0·20 ,,	0·208
0·05 ,,	0·039
0·20 ,,	0·170
0·40 ,, (3 c.c. $K_2C_2O_7$ Sol.)	0·308

Having ascertained the reliability of the method, where the alcohol was diluted with water only, the effect of the presence of other substances was tried. Städeler has shown that albumin, fibrin, gelatin, and lactic acid yield a trace of aldehyd when treated with sulphuric acid and bichromate of potash, or peroxide of manganese; hence these compounds must be removed from solution before the test is applied. No substances, with these exceptions, besides the ethyl compounds, are known to yield aldehyd when thus treated. Various essential oils, chloroform, amyl alcohol, &c., were shaken with water and the solution distilled with these oxidising agents, but no yellow colour was produced. The distillate from clove water was pink, but when 0·1 per cent of alcohol was added the pink tint was quite overpowered by the yellow colour of the aldehyd resin produced. Ether, of course, yields aldehyd when oxidised; hence this will not serve to detect alcohol in ether. To detect alcohol in essential oils and chloroform, agitate the sample with an equal quantity of water, and when the aqueous solution has become clear, remove with a pipette and distil with the bichromate and acid; 0·5 per cent is thus easily detected. The subjoined table gives the results of several quantitative experiments. Four c.c. of the substance examined were shaken vigorously with 8 c.c. of the dilute acid and 92 c.c. of water, and when clear 50 c.c. of the acid liquid placed in a flask and distilled with a sufficient quantity of bichromate. Ten c.c. of distillate are collected in a tube containing 2 c.c. of soda solution, and boiled, diluted, and Nesslerised

Name, &c.	Quantity of Bichromate Solution added.	Result.
Oil of Lemons	2 c.c.	none
Ditto, with 5 per cent alcohol ..	2 ,,	3·60 p.c.
Oil of Rosemary with 5 p.c. alcohol	2 ,,	3·90 p.c.
Oil of Bergamotte	2 ,,	none
Ditto, with 10 p. c. alcohol	2 ,,	9·70 p.c.
Oil of Lavender, English	3½ ,,	none
Ditto, Foreign	3½ ,,	3·60 p.c.
Ditto, Foreign, with 2½ p.c. alcohol	3½ ,,	6·30 p.c.
Ditto, Foreign, washed	3½ ,,	none
A pure chloroform	2 ,,	a trace
Ditto, with 5 p. c. alcohol	2 ,,	4·20 p.c.
With 1 p. c. alcohol	2 ,,	0·92 p.c.

The oil of lavender (ext.) was undoubtedly adulterated, since, after being washed with water and examined, no reaction was obtained. Deducting 3·6 from 6·3, we have 2·7 as the percentage of alcohol added.

Alcohol is said not to suffer decomposition in presence of pure water. To confirm this a sample of well-boiled water had 0·1 per cent of alcohol added, and determinations made daily. After ten days the quantity of alcohol was found undiminished. An impure tank water, to which 0·1 per cent of alcohol had been added, did not contain a trace twenty-four hours afterwards. The presence of decaying organic matter of all kinds has this effect, and no doubt this reaction is in some degree a measure of the quality of a water.

Rajewsky (Pflüger's *Archiv.*, xi., 122, abs. *Y.B.P.*, 1876, 125) when investigating the action of alcohol upon the system, its passage into the brain and muscle, and the length of time which it remains there, came to the conclusion that the iodoform test is either not applicable to the detection of alcohol in the tissues, or that alcohol is a normal constituent of brain and muscle. I have applied the aldehyd test to a number of infusions of fresh muscle, or rather to the distillate from this infusion, but have failed to detect the slightest trace of alcohol.

The chromic acid reaction is still often quoted as a test for alcohol in the urine, but as shown by Chaumont (abs. *Y. B. P.*, 1855, 147) the test is not to be relied upon, even when applied to the distillate. A number of experiments were tried with various samples of urine, with and without the addition of alcohol. By adding a sufficient quantity of bichromate to oxidise all the oxidisable matter present in the urine good quantitative results were obtained. By

distilling the urine and estimating the alcohol in the distillate, the results were all much too low; but when about a grm. of ferrous sulphate was added to the urine previous to distillation the results were much more approximate. Should the urine contain albumen it must be distilled and the distillate examined, but otherwise equally good results are obtained without distillation. After partaking of an alcoholic fluid distinct traces of alcohol are found in the urine two hours afterwards. The quantity (after taking 12 c.c. of absolute alcohol) in the urine two hours after was about 0·02 per cent, and about the same proportion was found ten hours afterwards, and traces were present for upwards of twenty-four hours, Forty hours after no alcohol could be detected. From the quantity of urine excreted the results of two determinations went to show that not more than 0·7 per cent of the alcohol taken passes in the urine unchanged.

By concentrating fluids, supposed to contain alcohol by one or more distillations, exceedingly minute traces can be detected by this process, especially if only one-tenth instead of one-fifth be distilled.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 18, October 28, 1878.

Decomposition of Hydracids by Metals.—M. Berthelot.—If the metallic chlorides are arranged in a series according to the degrees of heat evolved on their formation, we are led to consequences which do not agree with the old classification of metals, arranged in sections according to their power of decomposing pure water and acids with liberation of hydrogen. According to this series the heat of formation of gaseous hydrochloric acid from its elements, +22·0, is surpassed by the heat of formation of all the anhydrous chlorides, even those of lead, copper, mercury, and silver, gold being the sole exception among the ordinary metals. All these metals, therefore, except gold, ought to decompose hydrochloric acid. Even after having made the necessary allowance for the fact that hydrogen and hydrochloric acid are gases, whilst the metals and their chlorides are solids, hydrochloric acid ought still to be decomposed, with evolution of hydrogen, by all the metals except gold, platinum, and perhaps palladium. As regards all the metals formerly arranged in the three first sections the fact is well known. Lead behaves similarly, even in the cold with concentrated acid. With copper the action is the same, though slower. Dry hydrochloric acid is decomposed by mercury at 550° to 600°. The reaction can be shown more distinctly by passing dry hydrochloric gas, charged with mercurial vapour, through a tube of porcelain heated to between 800° and 1000°. Pure silver decomposes pure hydrochloric gas at from 500° to 550°. Theory indicates and experiment confirms analogous reactions with hydrosulphuric acid, and still more decidedly with hydrobromic and hydriodic acids.

The Didymium of Cerite, probably a Mixture.—M. Delafontaine. — Since the interesting researches of Mosander, the results of which have been confirmed by MM. Marignac, Bunsen, Cleve, &c., didymium has been accepted as a simple body. All these chemists have worked upon the cerite of Bastnoes, and none of them seem to have made a comparative study of the didymium derived from other minerals. The author's former experiments on didymium from gadolinite led him to suspect that didymium is not a simple body, and these suspicions have been strengthened by certain recent observations on samarskite from the United States. The solutions of didymic salts yield a fine absorption spectrum, characterised by numerous bands and rays, the positions of which have been determined by MM. Bunsen and Lecoq de Boisbaudran. But the author finds that solutions of didymic nitrate from samarskite yield a spectrum less complete than that from cerite. In the least refrangible portion of the blue ceritic didymium displays a group of four narrow bands, nearly equidistant. In didymium from samarskite the author has not been able to detect this group, and he concludes, consequently, that ceritic didymium contains a new element, characterised by the blue bands above-mentioned.

Magnetisation of Steel Tubes.—M. J. M. Gaugain.—On submitting to the action of a feeble current, a system formed of two parts, having different coercitive forces, the part having the smallest coercitive force will become the more strongly magnetised.

A Warning Telephone.—M. Perrodon.—The author points out that, to remain in communication with a telephonic correspondent, it is necessary to keep the instrument applied to the ear, and to listen very attentively. He has devised a system of giving notice when a message is about to be sent.

Transformation of Valerylen into Terpilen.—M. G. Bouchardat.—This change has been effected by keeping valerylen for six hours in sealed tubes at 250°—260°, and in an atmosphere of carbonic acid.

Artificial Formation of Melanochroite.—S. Meunier. has placed fragments of galena in a dilute aqueous solution of potassic bichromate, and after the lapse of six months has obtained substances having the physical characters of melanochroite.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin No. 11, 1878.

On Certain Derivatives of Hydro-toluquinon.—A. Nietzki.—The author obtains a diacetyl derivative by heating along with acetyl chloride. He has also prepared three derivatives of the respective compositions $C_9H_{12}O_2$, $C_{16}H_{16}O_4$, and $C_{16}H_{18}O_4$

Oxidation of Cuminic Acid by Potassic Permanganate.—R. Meyer.—The author obtains a new acid, $C_{10}H_{12}O_3$, and describes certain of its salts.

Constitution of the Vapour of Acetic Acid.—A Horstmann.—The result of the author's experiments is not in accordance with the view of Playfair and Wanklyn, that the abnormally changeable vapour-density of acetic acid may be explained by the dissociation of a polymer of the acid.

Synthesis of Indigo-Blue.—Adolf Baeyer.—In the series of operations which, according to the author's previous communication, lead from phenyl-acetic acid to indigotin, the last link—the conversion of isatin into indigotin—was unsatisfactory, both as regards the clearness of the process and the yield. The mixture of reagents—consisting of phosphoric trichloride, acetyl chloride, and phosphorus—used to effect the reduction of isatin can act in various directions, and the product is by no means pure indigotin, but consists chiefly of indigo-purpurin. The action of phosphoric pentachloride upon acid amides, to which isatin belongs, is the key to the problem. If isatin is heated gently with this compound a lively reaction sets in, hydrochloric acid being given off, and the mass taking a brownish red colour. On the addition of water a brownish yellow mass is separated, which is insoluble in carbonate of potassa, and in contact with caustic potassa is re-converted into isatin. This substance is doubtless the imido-chloride of isatin. This compound yields indigotin by reduction. If heated gently with yellow phosphorus the red colour of the mass passes into green, and on the

addition of water indigo-blue is deposited after a short boiling. Or, if the isatin chloride is dissolved in alcohol and treated with zinc powder and acetic acid, the same result ensues. Or the mass obtained by the reaction of phosphoric pentachloride upon isatin is washed first with water, then with carbonate of soda, and is lastly treated with an alcoholic solution of yellow ammonium sulphide. When boiled the liquid turns green. and on the addition of water and repeated boiling it becomes blue. The yield is considerable.

Diimido-phthalein of Phenol.—A. Baeyer and J. B. Burkhardt.—An examination of the diimido-phthalein, tetra-brom-diimido-phthalein, and dibrom-dinitro-diimido-phthalein of phenol.

Dioxy-benzophenon from Phenol-phthalein. — A. Baeyer and J. B. Burkhardt.—The authors obtain this compound by dissolving 5 parts phenol-phthalein in a minimum of caustic potassa, and melting it over the open fire after the addition of 20 parts solid potassa. The violet colour of the melt passes gradually into red, and then into yellow. The process is interrupted when only a faint redness remains. From the aqueous solution of the melt acids cause the separation of long colourless needles, which are boiled in water to remove adhering benzoic acid, and then re-crystallised after treatment with animal charcoal.

Brom-rosoquinon from Phenol-phthalein. — A. Baeyer and C. Schraube.—Five parts of amorphous tetra-brom-phthalein are dissolved in 250 parts concentrated sulphuric acid, and the solution of 5 parts saltpetre in 50 parts sulphuric acid is quickly added. The mass is cooled and agitated, and allowed to stand for fifteen minutes. The precipitate obtained by mixing the deep violet liquid with water is washed first with water, then with alcohol, and boiled in a mixture of alcohol and chloroform, by which it is rendered crystalline without being perceptibly dissolved. It forms beautiful crystals, red by transmitted and steel-blue by reflected light. In concentrated sulphuric acid it dissolves without decomposition, and with a violet colour; in other solvents it is substantially insoluble. By treatment with alcoholic potassa it is converted into a colourless hydroquinon.

Experiments on the Oxidation of certain Non-saturated Bromo-, Chloro-, and Chlorbromo-hydrocarbons, by means of Free Oxygen.—E. Demole and H. Durr.—The conclusions drawn are that when a bromo-, chloro-, or chlorobromo- substitution-product of ethylen becomes polymerised on exposure to the air, it is also capable of absorbing oxygen at different temperatures. When such polymerisation does not occur no oxidation takes place.

Experiments and Theory on the Conversion of $C_2H_2Br_2$ into $C_2H_2OBr_2$ by means of Free Oxygen.—E. Demole—Not adapted for useful abstraction.

Derivatives of *a*-Naphthoquinon.—T. Diehl and V. Merz.—An examination of naphthalic acid, nitro-naphthalic acid, amido-naphthalic acid, with their respective salts and dioxy-naphthoquinon. This last compound differs from naphthazarin by the circumstance that the latter yields no phthalic acid.

On certain Selenio-cyanates.—J. W. Clarke.—An examination of the double selenio-cyanates of platinum.

Oxidation of Xylol-sulphamides.—M. W. Iles and Ira Remsen.—This paper forms part of a controversy between the authors and Dr. Jacobsen. (See *Berichte*, xi., 893.)

On Dimethyl-uric Acid.—C. J. Mabery and H. B. Hill.—This acid, $C_7H_8N_4O_3$, is formed by treating dry neutral urate of lead with methylic iodide in excess.

On Diphenols.—L. Barth and J. Schreder.—The authors distinguish two isomeric diphenols, *a* and *β*, and describe their characteristics and certain of their derivatives.

On a Fluorescein-carbonic Acid. — J. Schreder.—The acid in question, $C_{21}H_{12}O_7$, is very sparingly soluble in boiling water and glacial acetic acid, but dissolves readily in alcohol, ether, and benzol. The author describes its calcium and barium salts, the acetyl product, and the dibrom- and tetrabrom-fluorescein carbonic acids.

Products of the Reduction of Elemi-Resin by Zinc-Powder.— G. Ciamician.—The products are toluol, meta- and para-ethyl-methyl-benzol, and ethyl-naphthalin. Naphthalin and methyl-anthracen are found merely in scarce distinguishable traces.

Rosolic Acids.—H. Caro and C. Graebe.—The authors describe the formation of dioxy-benzophenon from aurin, the synthesis of aurin from dioxy-benzophenon, and the formation of a colouring-matter from mono-oxy-benzophenon and phenol.

Action of Phosphoric Pentasulphide upon Organic Acids.—C. Böttinger.—The acids in question are the pyrotartaric, pyruvic, and lactic.

Molecular Magnitude of Indigo.—E. v. Sommaruga.—The mean of nine determinations of the vapour-density of indigo, taken at the temperature of melting sulphur, is 9·45. The number calculated for the formula $C_{16}H_{10}N_2O_2$ is 9·06.

Acids of Wood Vinegar and their Connection with the so-called Wood-Oils.—G. Kramer and M. Grodzki.—The authors have found the following saturated acids present in quantity, and have succeeded in isolating them:—formic, propionic, butyric, and valerianic. Amongst unsaturated acids they have detected the crotonic and angelicic.

Diversity of the Absorption Spectra of one and the same Substance.—H. W. Vogel.—The author sums up the results of his researches as follows:—Between the spectra of a body in its solid state, in solution, and in a gaseous condition, there exist very important distinctions. Characteristic bands which appear in one state of aggregation are found in others either not at all or changed in position, in intensity, or in appearance. Copper sulphate and chlorophyll have the same absorption in the solid state and in solution. The spectra given by one and the same body in different solvents vary in some cases not at all, in others merely by the position of the bands, and in others again by a total difference of character. Kundt's law, that the absorption-bands of a dissolved body move more towards the red the stronger the dispersion of the liquid for the region of the absorption-band, in many cases does not hold good; sometimes the bands are even moved towards the blue in a more strongly refractive liquid; in other cases their position in different media remains the same. The position of the absorption-bands in the spectra of solid and dissolved bodies can only exceptionally be taken as characteristic of the bodies in question. Totally different bodies display absorption-bands exactly in the same position, whilst other bodies which closely approximate to each other show under similar circumstances striking distinctions in the situation of their bands. The majority of polychroic substances in the solid state display different colours and different spectra according as they are viewed from different directions: most other bodies in the solid state show different from what they possess when dissolved, and in the latter case, again, differences arise according to the nature of the solvent. Thus it is an open question which is the true spectrum of the substance. We go much too far if, from the accidental coincidence of the positions of the bands of two bodies, we infer their identity or chemical similarity.

Trinitroso- and Trinitrophloro-glucin. — R. Benedikt.—Not adapted for abstraction.

Contribution to the Knowledge of the Alizarin Colouring-matters and Green Alizarin Dyes.—H. W. Vogel.—An examination of the spectra of alizarin-blue, alizarin-orange, and malachite-green. The last-mentioned

colour, when dissolved in alcohol, gives exactly the same spectrum as aldehyd-green, although the chemical behaviour of the two colours is quite distinct.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 6, October 10, 1878.

This issue contains no original chemical matter.

No. 7, 1878.

Soap and Candle Manufacture.—We have a long account of the improvements in the stearine manufacture due to M. de Milly, who is described as having been concerned in the formation of all stearic acid works in Europe.

NOTES AND QUERIES.

Zinc Ashes.—These are collected from various parts of England, and sent to Swansea for reduction. I should like to know what treatment they undergo.—CARBON.

A New Method of Testing the Purity of Milk by the Hydrometer.—The lactometer, as used by dealers in milk and others for testing the purity of milk, is a most unsatisfactory instrument, and therefore cannot be used as a quick method of testing milk, samples of pure milk that were tried with the lactometer showing a supposed adulteration of 20 per cent of water, while those that were skimmed and watered registered pure milk upon the lactometer. The method that I have employed, of using the hydrometer for the rapid estimation of water in milk, is as follows, it being now an established fact that the sugar and the salts in milk are most constant: I propose to separate these from the other constituents, and to take the specific gravity of the serum:—Take a certain quantity of the milk to be examined, and then add about three drops of acetic or hydrochloric acid; well stir with a glass rod, and strain through a fine hair sieve; then filter through blotting-paper. If now we place the hydrometer in the serum, if water has been added the amount will be readily shown. Of course we must mark and test the hydrometer with a known sample of pure milk, and when it is properly graduated we have a most sensitive instrument, which can be used at the Railway Stations to test the milk upon arrival, the whole operation not taking more than three minutes, and will show at a glance the smallest amount of added water. If the milk has been coloured, the addition of a small piece of potash to the serum will immediately darken it: while the serum from pure milk is quite clear, that from coloured milk has a yellow tinge. Mr. E. Atkins, chemist, of 200, Essex-road, is now supplying these instruments, properly graduated, for the use of doctors, milk-dealers, and others engaged in testing milk.—A. SMITH, Chemical Laboratory, 198, Essex-road, Islington.

MEETINGS FOR THE WEEK.

SATURDAY, 23rd.—Physical, 3. "On a Condenser of Variable Capacity," by C. Boys.
MONDAY, 25th.—Royal Geographical, 8.30.
—— Medical, 8.30.
TUESDAY, 26th.—Civil Engineers, 8.
—— Anthropological, 8.
WEDNESDAY, 27th.—Society of Arts, 8.
SATURDAY, 30th.—Royal, 4. (Anniversary).

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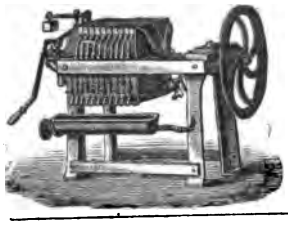

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 992.

OZONE AND THE ATMOSPHERE.*

By ALBERT R. LEEDS Ph.D.

(Concluded from p. 251.)

Examination of Ozonoscopes under known Conditions.—Having prepared pure materials, the following ozonoscopes were made, care being exercised to render them as nearly similar and uniform as the nature of the tests would permit. They were preserved in tightly-stoppered bottles in the dark, and entirely removed from the laboratory odours. The potassium iodide papers were made with a solution containing 15 grms. of the salt. The proportion of iodide of potassium and starch in the iodo-starch papers is that recommended by the observers whose names they bear. The amount of water is the same in all, in order that the papers compared may be as nearly similar as possible.

Name of Ozonoscope.	Potassm. Iodide. grms.	Starch. grms.	Water c.c.
Polli's	2·0	1·0	60
Moffat's	0·4	1·0	60
Lowe's (with 0·03 grm. calcium carbonate)	0·2	1·0	60
Schönbein's	0·1	1·1	60
Osann's	0·1	1·0	60
Cadmium iodide 1 grm. ..	—	1·0	60

The preparation of the other tests is given elsewhere. The tests prepared with great excess of potassium iodide, as recommended by Dr. Polli, were not employed, since they turned brown while drying. The sensitiveness of these tests, as will be seen from the tables, increases as a rule with the percentage of potassium iodide. Those of Lowe, which occupy an intermediate position and are not liable to change on drying, are perhaps to be preferred. Calcium carbonate was added in accordance with the recommendation of Mr. Lowe, in order to secure greater uniformity of action and prevent souring, but we were unable to perceive that the addition was of practical value.†

The tests were separately suspended in a capacious bell-jar, through which a current of ozonised oxygen (containing 1 m.grm. ozone in the litre) was caused to flow very slowly. No attempt was made to screen them from diffused light. In the first place, they were simultaneously exposed while dry for certain intervals. The effects were noted and expressed by numbers, the ozonoscope which had experienced the most striking change being placed first. They were then moistened, and the results indicated in like manner. Finally, in this moistened condition they were allowed to remain in the vessel, and their changes noted at the expiration of times indicated in the tables. The effect upon silver is not given because of its want of sensitiveness and its inapplicability as an atmospheric ozonoscope. (See Table on next page.)

It will be noted that potassium iodide is the most sensitive test, changing rapidly while dry, using this term to apply to papers having only such hygroscopic moisture as had been attracted from the atmosphere. The thallium papers are also very sensitive; but when exposed for some time in common with the other ozonoscopes, and then moistened, they fall behind the iodo-starch papers, which occupy an intermediate position between them and the potassium iodide test. The iodo-starch papers arrange themselves in an order corresponding to the amount of potassium iodide they contain, except the cadmium iodo-starch paper, which, unlike the other ozonoscopes of this class, does not on moistening after long exposure turn brown, but remains of a persistent blue.

In some trials it fell below the thallium, alizarin, and Houzeau tests in sensitiveness. It is important to note that the alizarin and Houzeau tests, whatever may be their other merits, are less susceptible than the potassium iodide and iodo-starch tests; and the manganese and lead sulphide are evidently inapplicable as atmospheric ozonoscopes.

Influence upon Ozonoscopes of Constituents of the Atmosphere other than Ozone.

OZONOSCOPES WITH NITROUS FUMES (VISIBLE.)

Ozonoscopes.	Dry.		When moistnd becme	
K I	Brown	(1)	Bleached	(1)
Cadmium ..	Lower end lilac, upper brown	(2)	Bluish black	(2)
Moffat	Brown	(5)	Dark blue	(3)
Lowe	Light brown	(6)	Dark blue	(4)
Osann	Lilac	(7)	Light blue	(6)
Schönbein ..	Light brown	(9)	Dark blue	(5)
Houzeau	Red	(8)	Red	(8)
Alizarin (with K I)	Brown	(10)	Unaltered	
Ditto (no K I) ..	Yellow	(10)	Unaltered	
Thallium ..	Doubtful			
Manganese acetate	Unaltered	(11)	Brown	(7)
Do. sulphate ..	Unaltered	(11)	Unaltered	
Lead sulphide	Bleached white	(4)	Unaltered	
Guaiacum ..	Dark blue	(3)	Unaltered	

The air in the bell-jar, in which the tests affected as above were suspended, contained nitrous fumes in quantity just sufficient to give a recognisable colour. In the following experiment the amount was extremely small, and no fumes were apparent:—

OZONOSCOPES WITH NITROUS FUMES (INVISIBLE).

Ozonoscopes.	Dry. 20 Minutes.	Dry. One Hour.	Moistened. Turned after 12 Hours.
K I	Yellow (1)		Brown
Cadmium ..	Unaltered	Unaltered	Dark blue
Moffat	Light brown (4)		(1) Dark brwn
Lowe	Unaltered	Light brwn (6)	(2) Brown
Osann	Light lilac (3)		(4) Brown
Schönbein ..	Unaltered	Faint lilac (7)	(3) Brown
Houzeau ..	Reddish (5)		Little chang'd
Alizarin (with K I)	Unaltered		Reddened ?
Ditto (no KI)	Unaltered		
Thallium ..	Light brown		Brown
Manganese acetate ..	Unaltered		
Do. sulphate	Unaltered		
Lead sulphide	Unaltered	Slightly blchd.	More blchd.
Guaiacum ..	Greenish (2)		Grnish-blue

OZONOSCOPES WITH SULPHUROUS ANHYDRIDE.

Ozonoscopes.	Dry.	Moistened.	Same after 12 hours.
Houzeau	Red		
Alizarin	Yellow red		
Mang. acetate		Turned brown?	Became white
Lead sulphide			A little bleach'd?

(The rest unaffected.)

Ozonoscopes (after Ozonising) with Sulphurous Anhydride.

(1.) Potassium iodide and all the iodo-starch papers bleached.

(2.) Thallium, after having been ozonised to a dark brown, is bleached.

* From proof sheets of the *Annals of the N.Y. Academy of Sciences*, furnished by the Author.

† E. T. Lowe, *Proc. Royal Society*, [12], p. 518.

First Series of Comparisons.

Ozonoscopes.	Dry. Half-an-hour.	Moistened. At Once.	Moistened. One Hour.	Moistened. Two Hours.
KI	Dark yellow	Brown	Brown	(1) Very brown
Cadmium	—	Lilac	Strong blue	(3) Dark blue
Moffat	Violet	Blue	Dark blue	(2) Black
Lowe	—	Faint blue	Dark blue	(4) Blackish blue
Osann	Not tried	—	—	—
Schönbein	,,	—	—	—
Houzeau	,,	—	—	—
Alizarin	,,	—	—	—
Thallium	,,	—	—	—
Manganese	—	—	—	(6) Brownish
Lead sulphide	—	—	—	—
Guaiacum	—	Light blue	—	(5) Blue

Second Series.

Ozonoscopes.	Dry. 5 Minutes.	Dry. 15 Minutes.	Moistened. At Once.
KI	Yellow	Brown (1)	(1)
Cadmium	—	Yellow (5)	(6)
Moffat	tr.	,, (4)	(2)
Lowe	—	— (6)	(3)
Osann	Lilac	Violet (2)	(5)
Schönbein	—	—	(8)
Houzeau	—	—	—
Alizarin	—	—	(7)
Thallium	tr.	Brown (3)	(4)
Manganese	—	—	—
Lead sulphide	—	—	—
Guaiacum	Not tried	—	—

Third Series.

Ozonoscopes.	Dry. 15 Minutes.	Moistened. At Once.
KI	Dark brown (1)	(1)
Cadmium	— (9)	(9)
Moffat	Grey (5)	(2)
Lowe	Greenish (7)	(3)
Osann	Lilac (6)	(4)
Schönbein	Faint lilac (8)	(5)
Houzeau	Blue (2)	(6)
Alizarin	Red (3)	(7)
Thallium	Brown (4)	(8)
Manganese	—	—
Lead sulphide	—	—
Guaiacum	Not tried	—

Fourth Series.

Ozonoscopes.	Dry. 10 Minutes.	Moistened. At Once.	Moistened. Half-an-hour.
KI	Yellow (1)	Yellowish red (1)	Same as before (1)
Cadmium	—	Blue (6)	Darker blue (5)
Moffat	tr. (4)	Dark blue (2)	Same (2)
Lowe	tr. (5)	Blue (3)	Same (4)
Osann (not tried)	—	—	—
Schönbein	—	tr. (7)	Blue (3)
Houzeau (not tried)	—	—	—
Alizarin	Redn'd (3)	Same as before (5)	Same (8)
Thallium	Brown (2)	,, ,, (4)	Same (6)
Manganese	—	—	—
Lead sulphide	—	—	—
Guaiacum	—	—	Blue (7)

(3.) Manganese sulphate and acetate remain intensely brown.

(4.) Guaiacum, alizarin, and Houzeau test little affected.

Carbonic anhydride had no effect on the ozonoscopes, either before or after ozonising.

Ozonoscopes with Hydrogen Peroxide.

Ozonoscps.	First Series.		Second Series.	
KI	Light yellow	(7)	Yellow	(10)
Cadmium	Faint lilac	(8)	Intense blue	(6)
Moffat ..	Light brown	(2)	Very dark brown	(1)
Lowe ..	,, ,,	(3)	Dark brown	(2)
Osann ..	?	(9)	Brown to blue	(3)
Schonbn.	Faint brown	(4)	,, ,,	(4)
Alizarin .	Red	(6)	Reddened	(8)
Houzeau	——		Bluish	(9)
Thallium	?		Unchanged	
Mangnse	Light brown	(5)	Not tried	
Lead sul.	Somewhat bleached	(10)	Bleached to grey	(7)
Guaiacm.	Blue (fine colour)	(1)	Beautiful blue	(5)

The hydrogen peroxide used in the first series was made from hydrated peroxide of barium by decomposing with hydrochloric acid. The papers were suspended for about fifteen hours over a solution containing 0·0044 grm. of the peroxide. Since the solution, prepared in this way, contained a little acid which had not been entirely removed, and this acid, by reacting with the peroxide, might liberate chlorine, a second series of trials was instituted. In this the solution had been prepared by decomposing with carbonic acid, and contained 0·5 per cent of the peroxide. The ozonoscopes were exposed during a like interval.

In a third series, the papers being exposed for forty-eight hours during day and night over a solution containing 0·2 per cent hydrogen peroxide, Moffat's turned to a brown colour, Osann's became brownish blue, guaiacum a beautiful light blue, alizarin reddened, Houzeau's test apparently changed somewhat in the direction of blue and afterwards was partly bleached, cadmium test became dark blue, potassium iodide quite white and damp, lead sulphide bleached to grey, silver was not affected. It is probable that the potassium iodide was decomposed, but became colourless again by conversion into iodate. This supposition was strengthened by the damp condition of the paper. The thallium test remained white, thallium peroxide undergoing reduction in contact with hydrogen peroxide, water and oxygen being liberated.

Action of Ozone upon the Colouring Matter of Flowers.—In connection with the use of organic colouring matters as ozonoscopes, experiments were made as to the action of ozone upon flowers. It is well known that indigo solu-

tion poured into a bottle filled with ozone is instantly bleached. In this case the colourless modification of indigo is formed. But attempts hitherto made to destroy the colouring matters of plants by ozone have yielded in our hands negative results. These results are striking as compared with those obtained by a reducing agent like sulphurous acid or with chlorine.

A light red rose was exposed for three hours to a current of 3½ litres of ozonised oxygen containing a little more than 1 m.grm. ozone per litre. No effect was discernible on either leaves or flower. In sulphurous acid it was bleached in the course of a few moments, though the chlorophyll of the leaves was unaffected. Returned to the ozone the blanched petals reddened, showing that the sulphurous acid with which they were impregnated had been ozonised. The same effect was produced by dilute sulphuric acid.

An abutilon, a yellow and a blue pansy, cineraria, red geranium, fuchsia, hyacinth, pink, violet, and heliotrope, were exposed for eighteen hours in a quart bottle filled with ozone. On opening the bottle no smell except the perfume of the flowers was apparent, and none of the flowers had changed except the violet and the heliotrope. These had turned slightly brown, due probably to natural wilting. Other specimens of the same flowers were placed in an atmosphere containing sulphurous acid. The heliotrope began to change immediately, and in ten minutes its colour had entirely disappeared. The hyacinth followed, and in the same length of time only streaks of red remained. The bouvardia was nearly white: the fuchsia, japonica, geranium, and cineraria were somewhat bleached; the yellow pansy not noticeably affected. At the end of three hours and a half the darker portion of the fuchsia was nearly bleached, the geranium had become pink, the blue pansy was of a yellow colour somewhat darker than the yellow pansy, the abutilon still unchanged. Flowers of *Salvia splendens*, *Camellia Japonica* (red), *Strelitzia regina*, *Abutilon venosum*, *Abutilon insigne*, *Inga pulcherrima*, *Ixia*, *Cineraria*, *Nasturtium*, *Azalea Indica*, and *Bouvardia* were exposed for thirty-six hours to ozonised oxygen, most of the time to a slow continuous current. A few light spots appeared on the azalea and nasturtium, and there was a slight discolouration of the camellia. Similar specimens, left for three hours in an atmosphere containing sulphurous acid, changed greatly: the camellia became lighter in spots and finally pink throughout, the azalea turned yellow and finally white, the *Abutilon venosum* saffron-yellow, the change beginning at the outer edge of the flower; the cineraria was somewhat lighter in colour; the *Salvia splendens* white in spots, other portions red.

The *Ixia* had become white; the long ends of the mimosa (*Inga*) were also bleached; the reddish markings of the nasturtium had quite disappeared. The flowers of the *Bouvardia* were bleached at their outer edge; in the *Strelitzia* neither flower nor leaf was affected. The same is true of the leaves of all the specimens.

After eighteen hours more of exposure the yellow portion of the *Strelitzia* was not affected, but the blue had become quite white; the mimosa was a faint pink, the nasturtium a deep yellow throughout; and the *Salvia* bleached entirely. Even after this length of time the chlorophyll of the leaves had undergone no change. When these same flowers were transferred from the sulphurous acid to a current of ozonised oxygen the azalea turned red on the edges and coloured somewhat throughout; the camellia reddened, so likewise the mimosa; the *Abutilon* became red along the veins; the petals of *Ixia* turned red at the edges; the nasturtiums reddened in places; the *Bouvardia* became brown; the *Strelitzia* did not change.

When similar flowers, which had been longer exposed to ozone without change, were placed in an atmosphere containing chlorine, the camellia became buff colour, its leaf unaffected; the azalea turned yellow, then white, its leaves partly changing also; the *Ixia* and *Bouvardia* became perfectly white; *Salvia*, yellow-white, its leaves yellow. The red veins of the *Abutilon venosum* were not bleached, but its green calyx and part of the stem were. The leaf of the *Abutilon insigne* was bleached in spots he leaf and stem of the nasturtium became entirely white. The blue portion of the *Strelitzia* was bleached, the yellow in part, the red leaf not affected. Corresponding changes took place in other specimens of these flowers which had not been previously exposed to ozone.

The action of ozone as a bleaching agent differs not only from that of sulphurous acid, as might be expected, but also from that of chlorine; and it is not improbable that its use has been proposed for bleaching in cases where its precise action has been unknown.

It is a striking fact in the economy of nature that an agent like ozone, which operates as nature's purifier and disinfectant, and energetically destroys decomposing and putrescible organic substances, should have so little action upon the delicate colouring matter of flowers.

Stevens Institute of Technology, May, 1878.

THE URIC ACID GROUP.

By P. T. MAIN.

In the Introduction to Hermann's "Physiology" uric acid is represented as tartronic di-cyanamide, a body related to tartronic acid as oxamide is to oxalic acid, with the difference that the part played by ammonia in reference to oxamide is taken by cyanamide in uric acid. This formula has the merit of showing very conspicuously the relation of uric acid to tartronic acid; and when the facility with which cyanamide is converted into urea is borne in mind, the reactions by which uric acid itself, or derivatives of it, yield urea (or the products of its oxidation) are suggested at once by the formula, and are seen to flow from the constitution—tartronic dicyanamide—of which it is but a shorthand representation.

The following formulæ are based on a similar plan, it appearing that the derivatives of uric acid can generally be expressed by supposing them to be related to a few acids (as tartronic, mesoxalic, malonic, &c.) mostly as amides or cyanamides; while some (as alloxantin, murexide, &c.) may be considered as resulting from the coalescence of two such derivatives with elimination of water. The derivatives thus formulated are given in groups, each group under the head of the acid to which it is most nearly related.

Derivatives related to *Tartronic Acid*—

COHO
CHHO
COHO

Uric acid—

$\overline{CONHCN}$
CHHO
$\overline{CONHCN}$

Dialuric acid—

$\overline{CONHCN}$
CHHO
COHO

Dialuramide (uramil)—

CONHCN
CHHO
$CONH_2$

Pseudo-uric acid—

$\overline{CONHCN}$
CHHO
$\overline{CONH_3CNO}$

Violuric acid—

$\overline{CONHCN}$
CH(NO)
COHO

Dilituric acid—

$\overline{CONHCN}$
$CH(NO_2)$
COHO

Derivatives related to *Mesoxalic Acid*—

COHO
$C(HO)_2$
COHO

Alloxanic acid—

CONHCN
$C(HO)_2$
COHO

Alloxan—

$\overline{CONHCN}$
CO
COHO

Uroxanic acid (?)—

$\overline{CONH_3CNO}$
$CHONHCN + H_2O$
COHO

Oxonic acid (?)—

$CONH_2$
$\overline{CHONHCN}$
COHO

Derivatives intermediate between those related to tartronic acid and to mesoxalic acid :—

Alloxantin ($+H_2O$)—

$CHO.COHO.\overline{CONHCN}$
|
$CHO.COHO.\overline{CONHCN}$

Murexide—

$CHO.CONH_2.\overline{CONHCN}$
|
$CHO.CONH_2.\overline{CONHCN}$

Purpuric acid—

$CHO.CONH_2.\overline{CONHCN}$
|
$CHO.COHO.\overline{CONHCN}$

Hydurilic acid—

$C.COHO.\overline{CONHCN}$
||
$C.COHO.\overline{CONHCN}$

Derivatives related to *Malonic Acid*—

COHO
CH_2.
COHO

Barbituric acid—

$\overline{CONHCN}$
CH_2.
COHO

Derivatives related to *Oxalic Acid*—

COHO
COHO

Parabanic acid—

$\overline{CONHCN}$
COHO

Oxaluric acid—

$\overline{CONH_3CNO}$
COHO

Oxaluramide—

$\overline{CONH_3CNO}$
$CONH_2$

Derivatives related to *Glycollic Acid*—

CH_2HO
CCHO

Hydantoin—

$CH_2\overline{NHCN}$
COHO

Hydantoic acid—

$CH_2\overline{NH_3CNO}$
COHO

Glycolurile—

$CH_2\overline{NHCN}$
$\overline{CONH_3CNO}$

Derivatives related to *Glyoxylic Acid*—

$CH(HO)_2$
COHO

Allantoin—

$\overline{CHHONHCN}$
$\overline{CONH_3CNO}$

Allanturic acid—

$\overline{CHHONHCN}$
COHO

The relations of the amorphous compound *Hydrazulmin*, formed by the mutual action of cyanogen and ammonia gases, may be traced in a not wildly improbable manner as follows, though the relations given are necessarily too hypothetical in the absence of sufficient data. Cyanamide is given by the following reaction :—

$$CNCl + NH_3 = HCl + NH_2CN.$$

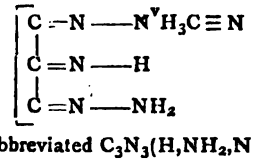
suppose C_2N_2 to act similarly ; then—

$$C_2N_2 + NH_3 = HCN + NH_2CN ;$$

the body $C_4H_6N_6$ may then arise thus—

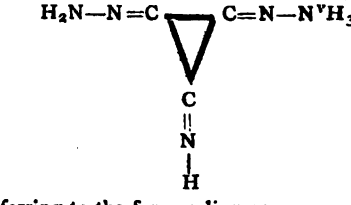
$$C_2N_2 + NH_3 + HCN + NH_2CN = C_4H_6N_6.$$

The combination may be supposed to take place between C_2N_2, NH_3, and $CN.NH_3CN$, the cyanide of cyanammonium, and the following formula may represent the interchange of atomicities :—



which may be abbreviated $C_3N_3(H,NH_2,NH_3CN)$.

This may be figured more symmetrically thus :—



Referring to the former diagram we may write—

Hydrazulmin—

$CN.\overline{NH_3CN}$
CN.H
$CN.NH_2$ or $C_3N_3(H,NH_2,NH_3CN)$.

Azulmic acid—

$CN.\overline{NH_3CN}$
CN.H
CN.HO or $C_3N_3(H,HO,NH_3CN)$.

Mycomelic acid—

$CN.\overline{NH_3CN}$
CN
COHO

Alloxan—

$\overline{CONHCN}$
CO
COHO

These formulæ may serve to show the relations to mycomelic acid of alloxan on the one hand, and hydrazulmin on the other.

In the above formulæ the urea, which is eliminated in various reactions, is generally represented by the residue NHCN or $NH_3CN.O$, replacing HO ; completing each of these by adding H, so that they become NH_2CN and NH_3CNOH, they are respectively cyanamide and cyanammonium hydrate, the conversion into urea being through two stages, of which the last gives urea either directly or by isomeric transformation. On the former view

urea is cyanammonium hydrate, *i.e.*, ammonium hydrate in which CN takes the place of H; thus, NH_4OH, ammonium hydrate; and NH_3CNOH, urea.

This view of the constitution of urea was suggested to me by its production in decompositions of uric acid and its derivatives.

The isomeric transformation of ammonium cyanate into urea suggests a similar view; for, just as Perkin has shown that ammonium glyoxylate undergoes isomeric change into an amide of glyoxylic acid, so we may suppose ammonium cyanate to become cyanamide, with the difference that in this case the water remains combined and is not—as in the formation of the amide of glyoxylic acid—eliminated; in this view urea is a hydrate of the substituted ammonia NH_2CN, and therefore differs from ammonium hydrate in the respect in which NH_2CN differs from NH_3, that is, in having H replaced by CN.

The formation of the compound ureas, and of sulphurea and the compound sulphureas, and some reactions of the latter, admit of similar explanation.

Mr. Fenton, by investigation of certain reactions of urea, has shown reason to suppose that the two nitrogens in urea are differently combined in the compound, a conclusion in harmony with some known reactions of urea, and with the view which the above considerations suggest—by whatever formula urea be represented—and inconsistent with the carbamide hypothesis. It is premature at present to give a constitution to urea; that it is carbamide is, I think, hardly possible to allow; but what it is can only be known by a further investigation of this body itself and its immediate derivatives, such as Mr. Fenton has undertaken.

In the meantime, it seems more in harmony with the present state of our knowledge to look upon urea as hydrated cyanamide or cyanammonium hydrate than as carbamide.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 21, 1878.

R. Warington, F.R.S., in the Chair.

After the reading of the minutes, &c., the following certificates were read for the first time:—C. E. Cassel, T. Gough, H. Wilson, S. Spencer, R. Gracey.

The Chairman then called on Prof. Church to read his paper entitled "*A Chemical Study of Vegetable Albinism.*" The author commenced by distinguishing albinism from chlorosis and icterus. Two sets of analyses were made, one upon leaves gathered in the autumn of 1877, the second on leaves gathered in 1878. Great care was taken in gathering the leaves, that they should be of the same age, &c.; no steel implements were used to separate them. The plants chosen for the first sets of experiments were the maple, the holly, and the ivy. In the second set, the plants (for which the author was indebted to Sir Joseph Hooker) experimented with were *Elæagnus pungens*, *Plectogyne variegata*, *Cyperus alternifolius*, and *Alocasia macrorhiza*. Both sets of analyses yielded the following results:—The ash of the white leaves contains much more potash and phosphoric acid than that of the green leaves. The ash of the white leaves contains much less lime than that of the green leaves. No deficiency of iron in the white leaves was detected. The details of all the analyses are given. The author made further enquiries with *Elæagnus pungens* as to the three following points:—The amount of matters soluble in ether; the proportion of albuminoid to total nitrogen; presence of calcium oxalate and carbonate. As regards the first, the white leaves yield less than half the amount of extractive given by the green leaves. Nearly 60 per cent of the nitrogen in the white leaves is non-albuminoid, while the green leaves contain 30 per cent in that condition. Calcium carbonate and oxalate were present in notable quantities in the green leaves, but almost absent from the white leaves. White leaves contain more (about 10 per cent) water than green leaves, while the dry organic matter in the former is not quite two-thirds of that present in the latter. To elucidate the question the author made some analyses of a parasite of the dodder and its host, the red clover. The parasite was found to be richer in water and in potash, but poorer in lime than its host, thus resembling a white leaf. White leaves, therefore, are related to green pretty much as immature leaves to mature, tubers to foliage, petals to green bracts, vegetable parasites to their hosts. The white leaf may thus be said to be parasitic on the green. The author does not give any decided opinion as to the cause of the whiteness: he remarks that white leaves are usually weaker, thinner, and that albino cuttings cannot be "struck." Some attempts have been made to stimulate albino foliage, but without any decisive results. The author promises further experiments, especially as regards the relations of equal areas of white and green foliage to carbonic acid, and the effect of injecting various substances.

Dr. Voelcker said the paper was one of great interest as indicating a new path which might lead to important results. He should like to ask if Prof. Church had paid much attention to the quantities of chlorides and nitrates.

The Chairman said that he had listened with great attention to Prof. Church's paper, as one opening out a new subject, and one which it was rather curious that no one, as far as he was aware, had investigated hitherto. In Germany analyses of beech leaves of all ages had been made, and in many respects the analyses of the young leaves corresponded with those of the white leaves, whilst the composition of the old leaves agreed with that of the green leaves. He should think, therefore, that in the spring Prof. Church would find less difference between the white and green leaves than in the autumn. The analyses of the parasite and its host seemed to afford a very good explanation of the differences between the composition of the white and green leaves. All the diffusible substances were found in the white leaves and the parasite, with but little non-diffusible matter.

Dr. Dyer remarked that albinism was a disease, probably due to the presence in the white leaf of some minute organism; for albinism can be communicated by grafting a normal plant with an albino shoot. White leaves resembled imperfectly fed leaves, preserving a sort of lingering vitality from their connection with a healthy plant, without which connection they could not exist.

Prof. Church, in reply, said that he attempted some chlorine and nitric acid determinations, but the results hitherto obtained were valueless.

The Chairman at this point announced that a ballot for Fellows would take place, and appointed Dr. Thudichum and Prof. McLeod as Scrutators. The ballot ensued, but was invalid because the requisite number of Fellows present did not vote.

The next paper was read by the Secretary, and was entitled "*Relation Between the Melting-Points of the Elements and their Coefficients of Expansion*," by Dr. Carnelly. Certain theoretical considerations led the author to the conclusion that the coefficient of expansion of an element by heat would be the greater the lower its melting-point. This conclusion the author has tested in the case of thirty-one elements, and finds that with five exceptions the coefficient of expansion increases as the melting-point diminishes; the five exceptions are As, Sb, Bi, Te, and Sn. A table and a graphic curve accompany the present paper, which the author promises to supplement by a communication, on a simple relation existing between the heat evolved by a chemical reaction and the melting-points of the reacting and resulting bodies.

The next paper was "*A Preliminary Notice on a Hydride of Boron*," by Francis Jones. After an unsuccessful attempt to prepare the above substance, by treating a product (magnesium boride), obtained by the action of sodium on a mixture of magnesium chloride and potassium borofluoride with hydrochloric acid, the author succeeded in preparing a spontaneously inflammable gas, which is doubtless hydride of boron, by first strongly heating a mixture of magnesium dust and boron trioxide,—

$$B_2O_3+6Mg=3MgO+B_2Mg_3,$$

and, secondly, treating the grey friable mass thus obtained with hydrochloric or nitric acid. The gas is colourless, burns with a bright green flame, and has a disagreeable odour. By using 3Mg instead of 6 in the above equation and treating the product with hydrochloric acid, amorphous boron is obtained as a brown powder.

The Society adjourned to December 5, when the following papers will be read:—"The Processes and their Comparative Value for Determining the Quality of Organic Matter in Potable Water," by Dr. Tidy; "Researches on the Action of the Copper-Zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe; "On a New Gravimetric Method for the Estimation of Minute Quantities of Carbon," by Drs. Dupré and Hake.

PHYSICAL SOCIETY.

November 23, 1878.

Prof. W. G. Adams, President, in the Chair.

Prof. W. E. Ayrton, late of the Imperial Engineering College, Tokio, Japan, read a paper written by himself and Prof. J. Perry, of the same College, "*On the Music of Colour and Visible Motion.*" The authors began by pointing out the well-known fact that emotion is excited by moving bodies, and they believed that upon this basis a new emotional art would be created which would receive a high development in the far distant future. All methods of exciting emotion could be cultivated; but of these, music, by reason of the facility with which its effects could be produced, had been highly perfected by the bulk of mankind. Sculpture and painting are not purely emotional arts like music, inasmuch as they involve thought. It would take a long time and much culture for the eye to behold moving figures with similar emotional results to those of the ear on hearing sweet sounds, but time and culture only might be necessary. It might be due to their neglect of this emotional tendency that the Western nations felt little emotion at moving visual displays. For among the Eastern nations they had entertainments consisting of motions and dumb show, which although incomprehensible and even ludicrous to the European, powerfully affected the feelings of a native audience. In Japan the authors had seen whole operas of "melodious motion" performed in the theatres, the emotions being expressed by movements of the body, affecting to the audience, which were quite strange to them. The accompanying orchestral music was, withal, displeasing to the authors; while, on the other hand, Western music is mostly displeasing to the Japanese. The emotions produced by rapidly moving masses—such as a train bowling up to a bridge, or by changing colours as in sunsets—have been felt by all. Harmonic instruments have been constructed to exhibit the combination of two or more pairs of harmonic motions to the eye; for example, Blackburn's pendulum, Lissajous's forks, Wheatstone's kaleidophone, and Tisley's harmonograph. Prof. Ayrton illustrated his remarks by exhibiting these instruments in action. The pendulum traced out the complex path of the combined motions by a jet of falling sand, the forks by a moving beam of light thrown on a screen, the kaleidophone by a bright bead, and the harmonograph by the involutions of an aniline pen. With none of these and such like instruments, however is the production of mere emotion the end in view; and in most of them no change can be made in the periods of the pairs of harmonic or periodic motions combined without arresting the instrument, a proceeding which in music would be analogous to stopping the tune at the end of every chord. There is no provision either for changing the amplitude or phase. A successful instrument in the new kinematical art must visibly render changes in period, amplitude, and phase of the harmonic motions represented. Profs. Ayrton and Perry had designed an instrument, which was now in Japan, for effecting these required changes in a combination of harmonic motions given to a moving body, and which they claimed to be the first musical instrument of the visual art in question. They had not given it a name yet because the nomenclature of the subject was uninvented. A diagram of this instrument was exhibited to the meeting. It consists of a mechanical arrangement of levers, pulleys, and cords, whereby two harmonic motions, one along a vertical and the other along a horizontal line, are compounded in the resultant motion of a suspended pane of glass. A black circle painted on the pane is intended to represent the moving body as projected against a wall or screen behind. The levers moving the pane are actuated by a revolving barrel, the periphery of which is carved according to mathematical principles, so as to give the different harmonic motions to the levers in one revolution. The motion is further regulated by shifting the levers, and by the angular velocity of the barrel. In this way the period, amplitude, and phase of the component motions of the glass, either in a vertical or horizontal direction, may be changed at will, and almost immediately. Other kinds of periodic motions may be compounded in a similar way. Prof. Ayrton also suggested other forms of apparatus for this purpose. Numberless combinations of graceful motions producing emotional effects on the beholder can by its means be given to a visible body. It is the intention of the authors to construct an improved form of the apparatus, and to arrange for the blending of colour with the moving body to heighten the emotional influence. For example, they purpose having changing mosaics of different hues thrown upon the screen for a back-ground to the black spot. This can be done by means of an instrument similar to the chromotrope, with its revolving sheets of parti-coloured glass. In conclusion, Prof. Ayrton said that there might yet be invented many different ways of producing these spectacles, and there was no reason why a whole city full of people should not enjoy these displays projected upon the clouds overhead.

In the short discussion which followed,

Dr. Stone pointed out that the Japanese employ a different scale to that of the western nations, and that therefore our music may seem odd to them as theirs is to us. The ethnological difference of ear between the Chinese race and ourselves is a subject worthy of investigation. He attributed the influence of pantomime on the Japanese to association, and asserted that music not only produced emotions but suggested ideas. The harmony of music, poetry, and motion were well known, and tone poet was a name given to composers.

Dr. Gladstone remarked that all the senses could be harmonised when sufficiently educated, as witnessed to by the art of the cook and the perfumer. Sugar and nitre when tasted separately were not disagreeable, but when tasted together the effect was very nauseous, and great quantities of beet-sugar had been vitiated by small traces of nitre from the beet-root.

Prof. Ayrton also alluded to the curious fact that certain persons on hearing music seemed to see changing colours or landscapes arise before them, and others see bright lights on hearing shrill sounds.

Dr. Schuster then described his new method of adjusting the collimator of the spectroscope for parallel rays of different refrangibility. His plan is very simple, and is based on the fact that if the rays entering the prism are parallel the focus seen in the telescope will remain con-

stant when the prism is turned round; but if they are not parallel the focus will shift. The process, therefore, consists in looking through the telescope while turning the prism. If the focus shifts the collimator has to be adjusted until no shifting takes place. The adjustment must be made with a prism whose sides are perfectly plane, and a good one may be kept for the purpose.

The Society then adjourned until December 14.

CORRESPONDENCE.

SODA MANUFACTURE.

To the Editor of the Chemical News.

Sir,—Noticing the article on the ammonia-soda process in the Chemical News, vol. xxxviii., p. 203, I afterwards thought it might interest some of your readers to see the outlines of a process for the manufacture of soda as a part of a process for the purification of coal-gas from carbonic acid as devised by me, and patented by Mr. R. W. Wallace and myself.

Means have long been sought to purify coal-gas by a liquid process to be carried on in permanently closed vessels, in such a way that the formation of solid refuse matter and its exposure to the surrounding atmosphere be avoided.

It is needless to enumerate the many and various methods already proposed by others for the solution of this problem, since most of them are known. All or most of them have for their basis the use of caustic ammonia in the liquid form. Everyone acquainted with the manufacture of gas admits the perfect feasibility and practicability of the purification of gas by means of liquid or gaseous ammonia. The difficulty hitherto in the way of carrying it out in practice was the economical production of caustic ammonia and its recovery over and over again without at the same time forming a solid refuse, worse to dispose of than the present lime or oxide waste.

In the process to be described the ammonia is produced by decomposing *chloride of ammonia by means of lime*. The chloride of calcium formed, which constitutes the only refuse matter arising from the working of the same, is easily disposed of, as it may be run into any river or sewer, and will there act even as an antiseptic and disinfectant.

The ammoniacal gas produced as stated above is admitted or conveyed in regulated quantities into the coal-gas as it leaves the retorts. It there takes up the impurities, carbonic acid and sulphide of hydrogen, and passes charged with these impurities along with the gas through a number of scrubbers. The ordinary open purifiers being for the most part dispensed with, a larger number of scrubbers are required. These are arranged into two or three groups, and the last one or two in each group are used for condensing or absorbing the compounds of ammonia formed.

The solution thus produced is pumped in a continuous manner from scrubber to scrubber in the direction from holder to the retorts. As it approaches the scrubbers nearest to the retorts the liquor becomes gradually poorer in sulphide of ammonium and richer in carbonate of ammonia, so that, arrived at the last of them, the liquor will be found to have absorbed *more* carbonic acid than is necessary to form with the ammonia present in it the monocarbonate of ammonia. Whilst this is the case there is generally at the same time sufficient sulphide of hydrogen present in the liquor to form, with about 15 per cent of the ammonia, sulphide of ammonium.

As the presence of bicarbonate of ammonia is, however not consistent with the simultaneous existence of sulphide of ammonium in the same liquid, the sulphide of hydrogen must exist in the free state; at any rate for the purposes of this description we will assume it to be so.

From the scrubbers yielding the liquor containing a maximum of carbonic acid and a minimum of sulphide of hydrogen, the liquor is withdrawn for the further operations of the process being described; that is to say, the liquor is either distilled and the vapours of carbonate of ammonia condensed in a solution of chloride of sodium, or, if previously concentrated, common salt is dissolved in the liquor in quantities equivalent to the carbonate of ammonia contained in the concentrated liquor, but allowing for the excess of chloride of sodium usually taken in the practice of the ordinary ammonia-soda process.

Pure carbonic acid derived from the decomposition by heat in closed vessels of bicarbonate of soda is next forced into the mixed solutions (by means of an air compressing engine); bicarbonate of soda is precipitated, which is drained or separated from the mother-liquor otherwise.

This bicarbonate of soda is heated, as mentioned, in closed vessels until it is converted into carbonate; the carbonic acid liberated is received into a gas-holder, and serves for carbonating the next batch of mixed solutions.

The mother-liquor, containing chloride of ammonium, common salt, and some undecomposed bicarbonate of ammonia, is next heated in boilers or stills, to drive off the carbonate of ammonia contained in it, which is collected.

After every trace of carbonate of ammonia is expelled the hot chloride of ammonium is run in regulated quantities into another still containing an excess of hot hydrate of lime. The ammonia liberated is admitted into the coal-gas and so forth—that is to say, the same above described operations are repeated again and again.

Thus the same quantity of ammonia will suffice to purify coal-gas to an unlimited extent of carbonic acid. This being the case, the ammonia derived from the distillation of the coals, and which accompanies the coal-gas, is therefore available for other purposes, and as the yield is equal to about four-fifths of an equivalent of the sulphide of hydrogen produced simultaneously, the whole of *this* ammonia may be used for the purification of gas from sulphide of hydrogen.

It is well known that gas lime, consisting in its early stage of sulphide of calcium and carbonate of lime, becomes by continued exposure to the impure coal-gas ultimately converted wholly into carbonate of lime, *i.e.*, the carbonic acid is retained whilst the sulphide of hydrogen is driven forward and carried along in the direction in which the coal-gas travels. Hence, whilst the nearest purifier contains carbonate of lime, some of those further removed contain sulphide of calcium only.

The same action will take place in scrubbers in which caustic ammonia is used as a purifying agent; carbonate of ammonia will be found in the first and sulphide of ammonium and caustic ammonia in the last. Thus the ammonia will absorb four-fifths of the sulphide of hydrogen contained in the coal-gas, leaving only one-fifth to be dealt with by other means.

To describe these and to enter further into the details of this process would cause this letter to become too voluminous, its object being merely to point out the enormous practical and commercial advantages arising from the combination of the two processes to each other. The purification of the gas would be capable of being carried on in permanently closed vessels—therefore no nuisance. This applies to all the operations from the generation of the ammonia for the purification of the gas to the production of the finished marketable soda-ash. Not one particle of the materials in use in all the intermediate stages of working need to see the daylight as it were. It would produce no solid refuse to be disposed of, but would, on the contrary, produce in the place of it an article of great value, selling at the present time for £11 per ton.

Looking at the process from the ammonia-soda maker's point of view, the latter will find advantages he never could dream of before. He is saved the cost and trouble of combining his caustic ammonia with carbonic acid and the loss of ammonia generally incurred in this operation,

nor has he anything to pay for his lime wherewith to decompose the chloride of ammonium.

I have it on good authority that the cost of production per ton of alkali in the works of Mr. Solvay, near Nancy, is £4 per ton. If from this figure is deducted the cost of lime and of the loss of ammonia occasioned by the combination of ammonia with carbonic acid (which loss is avoided in this process by all the ammonia compounds being conveyed back into the circuit of the gas plant); if it is further taken into consideration that a large amount for fuel may be saved in gasworks, where there is so much waste heat to be utilised, a figure as to the cost of alkali results which may appear almost ridiculous.

If a more general view is taken of the bearings of this process on the alkali trade the effect is more surprising still.

According to reliable figures obtained from several of the leading gas engineers of London and elsewhere as to the amount of carbonic acid in crude gas, the quantity of soda-ash (of 100 per cent of carbonate) which could be produced for each ton of coal carbonised in the gas works would be from 70 to 84 lbs. This means that in a gas works, like the Beckton gas works, about 750 tons per week of pure alkali could be produced, or if that works should represent, as it is assumed, or as I have heard it frequently stated, even two-thirds of the production of gas in London and suburbs, London would produce something like 1100 to 1200 tons of refined alkali per week. The remaining large towns of Great Britain would easily bring up the defficiency between that figure and, say, 4000 tons per week, or the half of total production of alkali in this country.

Any criticism on my statements by any of your readers will be welcome.—I am, &c.,

C. Claus.

16, Mark Lane, London, E.C.,
November 25, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 19, November 4, 1878.

Reciprocal Displacements between Oxygen, Sulphur, and the Halogens Combined with Hydrogen.—M. Berthelot.—According to the quantities of heat liberated chlorine ought to displace bromine and bromine should displace iodine, both in the gaseous hydracids and in those combined with water, which agrees with general experience. Chlorine and bromine ought to displace sulphur in sulphuretted hydrogen, whether gaseous or dissolved, as is shown by experience. The reaction is effected so much the more easily, as an excess of chlorine forms, with the sulphur set at liberty, chloride of sulphur, in the anhydrous state and in presence of water, several secondary compounds. Iodine ought to displace sulphur in dissolved sulphuretted hydrogen, forming dilute hydriodic acid; but, on the other hand, sulphur ought to decompose gaseous hydriodic acid, forming gaseous sulphuretted hydrogen, as actually happens. Oxygen should displace sulphur in sulphuretted hydrogen, gaseous or dissolved. Between chlorine and oxygen the thermic theory indicates the formation of an equilibrium. Oxygen ought also to displace bromine in hydrobromic acid, and iodine in hydriodic acid, both gaseous and dissolved.

Reciprocal Displacements between Weak Acids.—M. Berthelot.—Two feeble acids brought in contact share the base, the partition being regulated by the state of partial decomposition of the two salts, which depends at once on the proportion of water and on that of the corresponding acid.

Reaction between Mercury and Hydrochloric Gas.—M. Berthelot.—13·5 grms. of mercury and 48 c.c. of pure hydrochloric acid gas were placed in a well-sealed tube, and heated as strongly as possible for an hour. Rather more than 1 c.c. of hydrogen was obtained.

Maturation of the Grain of Rye.—A. Müntz.—The saccharine matter existing in the grain of rye appears to be synanthrose, a sugar discovered by M. Pope in the tubers of the Jerusalem artichoke. Synanthrose is not present in wheat, &c.

Dangers of the Industrial Use of Methyl Alcohol.—L. Poincaré.—Animals kept from eight to sixteen months in an atmosphere freely renewed, but charged with the vapour of methylic alcohol, presented during life an abnormal development of the abdomen. On a *post mortem* examination the liver was found greatly enlarged and in a state of fatty degeneration. A similar modification was traced in the muscular fibres of the heart, of the urinary passages, and of a great number of the pulmonary cells. There was also congestion of the nervous centres. The author urges that some other method of preparing alcohol for industrial purposes should be selected.

An Iodised Derivative of Camphor.—A. Haller.—The author in order to prepare a cyanogen derivative of camphor treated a benzolic solution of a mixture of iodised camphor and sodic borneol with a solution of iodide of cyanogen in the same hydrocarbon. The compound obtained was $C_{10}H_{13}IO$.

Reproduction of Felspar by Fusion and by Prolonged Exposure to a Temperature Bordering on Fusion.—F. Fouqué and M. Lévy.—The authors melted in a platinum crucible placed in a Schlœsing furnace either natural pulverised felspars or artificial mixtures of their chemical constituents.

Two Specimens of Natural Crystals of Epsomite of Remarkable Dimensions.—P. de Rouville.—The crystals were more than a centimetre in length.

Les Mondes, Revue Hebdomadaire des Sciences. No. 8, 1878.

Salaries of the Professors of the Faculties—It is very properly pointed out as unfair that whilst the salaries of professors in the faculties of law and letters have been fixed at 15,000 francs, those of the professors of medicine and science receive only 13,000.

M. Depelley proposes a contrivance by which the date, when a letter passes through the post-office, will be made to appear not merely on the envelope, but on the enclosed letter.

Note on the Optical Properties of Leaves of Gelatin.—A. Bertin.—The author observes that plates of glue and gelatin, as ordinarily sold, act energetically upon polarised light, after the manner of tempered glass. With a polarising microscope they yield in many parts fringes very similar to those of biaxial crystals, though irregular. The sheets of gelatin used by lithographers act differently, having constant and well-defined optical properties. They are obtained by pouring a hot concentration of glue upon a plate of glass previously washed with ox-gall to prevent adhesion, and fitted with a margin of wood or of pasteboard. The sheets of gelatin should have a mean thickness of 0·5 m.m.

Products accompanying Ethylic Alcohol.—Isidore Pierre.—A letter addressed to Prof. Dumas, and treating on the removal of aldehyd, propylic, butylic, and amylic alcohol, &c., from distilled liquors.

"Gluttony."—By M. Amédée Latour, and reviewed by "Dr. Simplice."—A work containing not a few doubtful and inconsistent propositions.

Chemiker Zeitung.
No. 41, 1878.

Chemical Industry at the Paris Exhibition (No. XI.)—Dr. C. Deite.—This chapter is devoted to the manufacture of stearine, a business of great importance in France. The largest works are those of F. Fournier, of Marseilles, producing yearly 4,286,000 kilos. of stearic acid and stearine candles.

Manufacture of Sulphate of Ammonia.—The works at Grätz produce yearly 10,000 metric cwts., and are very remunerative. The ammonia is obtained by mixing fæces with 2 to 3 per cent of lime in the form of milk, and distilling. The ammoniacal gas and steam saturated with gas are drawn into leaden neutralising receivers. The sulphuric acid employed is of the strength of 60° (probably Baumé), and the salt obtained is almost white. The town of Grätz, with a population of 100,000, yields daily 3000 pails of semi-fluid fæcal matter, about one-third of which is consumed in the above-mentioned works.

Immense deposits of gold have been recently discovered in Patagonia, and are said to extend from the Cordilleras to the ocean, and from Santa Cruz to Tierra del Fuego.

Various ornamental articles are now made from ox-blood. The dried, pulverised, and sifted blood is forced into moulds, which are heated to from 100° to 150°, and are then submitted for a few minutes to a very strong pressure. After cooling, the articles are polished, and are then ready for sale.

According to Vulpius phosphorus is soluble in acetic acid.

To render caoutchouc tubes impervious to coal-gas, Vulpius recommends that they should be coated with soluble glass.

No. 42, 1878.

At Königsberg certain military persons have been attacked with eruptions, ascribed to the green leather lining of their helmets, in which arsenic has been detected.

Petroleum has been in use in Japan for several centuries. In the province of Etshigo, on the north-west coast of Niphon, 600 oil-wells are in full flow. The petroleum only loses one-tenth of its weight in refining.

Dynamite, if brought in contact with water, undergoes a separation of its ingredients. The infusorial earth sinks to the bottom, whilst the nitro-glycerin floats on the surface, and on a slight rise of temperature explodes with its usual violence.

No. 43, 1878.

The total yearly production of soap in France is calculated at 220 million kilos.

Vincent and Lecann, of Havre, manufacture soaps in which petroleum is kept in a state missible with water by means of an addition of carnauba wax. This substance owes its efficacy to the presence of myricylic alcohol, which if added to petroleum renders it miscible with soap-lye.

An oil-well is said to have been discovered at Adlershof, near Berlin.

Dr. Wackenroder gives an account of the results of chemical and microscopic observations of food, &c., performed at Bernburg. The adulterations detected seem neither numerous nor novel.

Reimann's Färber Zeitung,
No. 44, 1878.

Dyeing with the Azo-Colours.—Tropeolin, orange, &c., can be satisfactorily fixed upon wool by means of alum and tartar, and if topped with eosin give scarlets comparable with those produced with cochineal. With oxalic acid and tin crystals the colours are reduced and the resulting shades are dirty. Topping with magenta and safranin is unsatisfactory.

MISCELLANEOUS.

Wall Decoration.—Under the name of Muralis, Mr. Frederick Walton is manufacturing a new Linoleum product for decorating walls. Muralis is a mixture of linseed oil and fibre, rolled on to a cotton fabric. On this material, ornamentation in relief is stamped by machinery with the greatest clearness, beauty, and sharpness of diversified outline. The use of colour in addition is optional, and the patterns may, if desired, be tooled after the first stamping. The effect produced is, according to the will of the designer, like that of carved wood, of embossed leather, of terra-cotta, or plaster ornamentation; or the work may be allowed to assume a character of its own as a subdued and graceful style of ornamentation. This new material is very durable; even a blow produces no lasting impression. For the interior decoration of houses its warm and comfortable surface makes it peculiarly applicable. There is at present at the show-rooms, at 9, Berners-street, in addition to many specimens of the material, a room entirely decorated with Muralis, which would appear to have all the qualities requisite for extensive use, being beautiful in effect and admirably clean and sanitary. A silver medal for the new product was granted this year at the Paris Universal Exhibition.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 2nd.—Medical, 8.30.
—— London Institution, 5.
—— Royal Institution, 5. General Monthly Meeting.
TUESDAY, 3rd.—Civil Engineers, 8.
—— Zoological, 8.30.
WEDNESDAY, 4th.—Society of Arts, 8.
—— Geological, 8.
—— Pharmaceutical, 8.
THURSDAY, 5th.—Chemical, 8. "The Processes and their Comparative Value for Determining the Quantity of Organic Matter in Potable Waters," by Dr. C. M. Tidy. "Researches on the Action of the Copper-zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe. "On a New Gravimetric Method for the Estimation of Minute Quantities of Carbon," by Dr. Dupré and Dr. Hake.
—— Royal, 8.30.
—— Royal Society Club, 6.30.
FRIDAY, 6th.—Geologists' Association, 8.

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An Examination in Practical Chemistry in connection with the Institute of Chemistry will be held during the last week of January next. Examiner, Dr. W. J. Russell, F.R.S. Candidates can obtain further information on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London, W.C.

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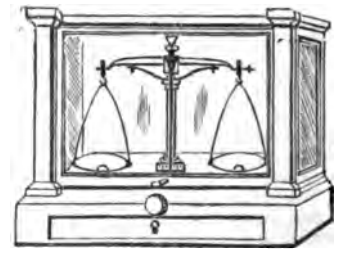
ROTTERDAM.  NEW YORK.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 993.

AMMONIUM NITRATE.

By SPENCER PICKERING.

THE melting-point of ammonium nitrate given in the various text-books is apparently incorrect. In the "Dictionary of Chemistry" it is stated to be 108° C.; in Miller, 107·8° C.; and in Gmelin it is stated that it melts imperfectly at 56° C., and perfectly at 108° C. But experiments on the crystallised substance, which had been dried at 100° C., invariably gave its melting-point as 165° to 166° C., whether it had been recrystallised from water or from alcohol; it was also found that the amount of water retained by the moist crystals after being pressed between blotting-paper (about 0·55 per cent) did not lower its melting-point more than 3° C.

Ammonium nitrate dissolves easily in alcohol, but is much less soluble in this liquid than in water. From either its alcoholic or its aqueous solution it is deposited, on cooling or on evaporation, in anhydrous crystals, which deliquesce only when exposed to very moist air. Portions of the substance which had been dried at 100° C., and which weighed about 1 grm., were exposed on watch-glasses to the air of the laboratory for about eighteen hours; crystals obtained from an alcoholic solution gained in this way 0·06 per cent of moisture; and those obtained from an aqueous solution gained in one case 0·06, and in another 0·15 per cent; crystals which have been dried by being pressed between blotting-paper will even lose a portion of the small amount of moisture which they contain, the loss varying from 0·01 to 0·1 per cent. Some of the powdered substance which had been dried at 100° C. was exposed to the air of the laboratory for ten days, after which it was found to contain 0·09 per cent of water; but on subsequent exposure to air perfectly saturated with moisture for twenty-two hours, it absorbed as much as 14 per cent of water. In another experiment, where the crystals had been obtained from an alcoholic solution, the absorption amounted to 32 per cent. Some of the fused salt gained under similar circumstances 3·3 per cent, becoming, as in the two previous experiments, partially liquefied. Ammonium nitrate is insoluble in ether.

On being heated above its melting-point it begins to decompose into nitrous oxide and water at about 185° C., and not at 250° C., as stated in Miller and elsewhere.

Oxford, December 1, 1878.

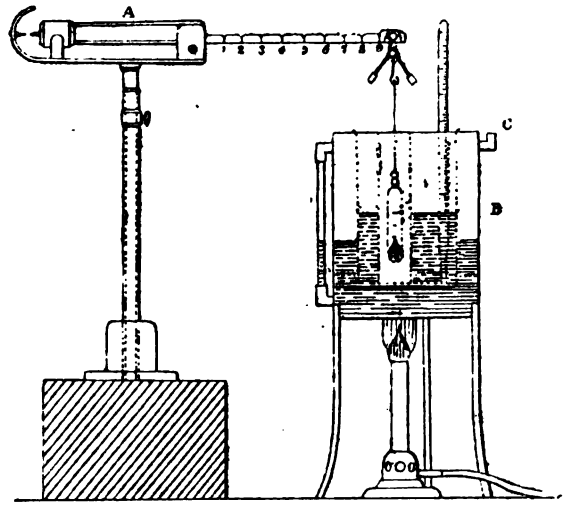
NOTES ON ESTCOURT'S BUTTER APPARATUS.

By J. CARTER BELL.

IN the CHEMICAL NEWS, vol. xxxiv., p. 254, is a description of this apparatus, together with the new method devised by Estcourt, for taking the specific gravity of fats at a constant temperature.

In the many analyses of butter which I have had to perform in my capacity as public analyst, I have found this apparatus of very great advantage, and can indeed say with truth that when once its value is known to analysts its use will be universal. I hold it to be incumbent upon all chemists who may try new methods of analyses or new forms of apparatus to give to their fellows in the scientific world the results of their experience, and with this view I have made the few preceding remarks. When I first examined the method as described I found great difficulty in comprehending it, owing to the omission of a cut of the apparatus. Owing to this omission (of a cut of the apparatus) the description to be found in the text is by itself rather difficult to understand; I therefore append to this note a sketch of the apparatus just as I use it.

A represents the Westphal balance with bulb immersed in the test-tube, containing the fat whose gravity it is desired to obtain. B is a vertical section of the bath, the outer casing of which is filled with water (outlet and inlet for water is marked c). The inner part of the bath contains paraffin, and in this the thermometer rests along with the test-tube containing the fat. Heat being applied the boiling water in the outer jacket melts the paraffin, which gradually arrives at a constant temperature, when



the weights on the arm of the balance are correctly adjusted, and the specific gravity is read off. The only precaution needful is to see that the plunger of the balance does not rest either on the bottom or the side of the test-tube; this is avoided by gently moving the balance slightly until under each change no difference is observed in the indicated specific gravity.

PHILIPPIUM.

By W. G. BROWN.

WHILE analysing sipylite in the laboratory of the University of Virginia during the winter of 1876-77, the solution of the earths occurring in connection with yttria was examined by means of the spectroscope.

In view of the fact that a new metal—philippium—(CHEMICAL NEWS, vol. xxxviii., p. 202) has been announced by Delafontaine, the following may prove of interest.

The earths of the yttrium group separated from those of the cerium group (CHEMICAL NEWS, xxxvi., 158) were dissolved in hydrochloric acid; the solution so obtained was placed in two cells, together about 20 c.m. in length. On passing the light of an Argand burner through this depth of solution and examining the transmitted light by means of an ordinary "Heidelberg laboratory" single prism spectroscope, an absorption-spectrum of great distinctness was obtained, consisting of thirteen bands, whose positions were noted, and a doubtful band in the extreme violet, none of which exactly agreed with the same number of bands obtained from a solution of a didymium salt with the same spectroscope. To only two of these bands need particular attention be drawn for the

present, one in the red, the other in the blue. The first gave $\lambda=6705$, and was noted "very faint;" the second was quite broad, its limits being $\lambda=4580$ and $\lambda=4490$, and is marked "deep black." This latter line agrees with the characteristic line of philippium, and denotes in all probability the presence of that earth in sipylite. Whether the red line is the same as that mentioned by Delafontaine I cannot determine, as this chemist does not give the wave length of the red ray observed by him.

These wave-lengths (6705, 4580, and 4490) are only approximate, and were determined by interpolation after the method given in Watts's "Index of Spectra." I was aided in this work by Mr. J. R. Santos, of Guayaquil.

East Tennessee University, Knoxville, Tenn.,
November 14, 1878.

ON THE DISTRIBUTION OF MANGANESE IN FERRO-MANGANESE ALLOYS.

By SERGIUS KERN, M.E., St. Petersburg.

CERTAIN observers have remarked that the manganese in ferro-manganese alloys is often very unequally distributed throughout the mass. It being interesting to execute some experiments in this direction, a piece of ferro-manganese weighing 1500 grms. was provided for this purpose. Six samples from different places were analysed. The results are the following:—

Samples.

	Percentages.					
	A.	B.	C.	D.	E.	F.
Silicon	0·20	0·19	0·20	0·20	0·20	0·19
Sulphur ..	0·02	0·02	0·01	0·02	0·02	0·01
Phosphorus ..	0·08	0·07	0·07	0·07	0·08	0·07
Manganese ..	45·60	47·10	46·80	45·46	44·90	46·70
Carbon	5·70	5·81	6·01	5·90	5·95	5·98

The manganese was estimated as mangano-manganic oxide by Eggertz's method. In order to study more closely this question several analyses of different ferro-manganese alloys are in execution, the results of which certainly will be of interest for metallurgists.

ON THE METALLURGY OF NICKEL AND COBALT.*

By W. A. DIXON, F.C.S., M.I.C.

SHORTLY after the discovery of the large deposits of nickel and cobalt ores in New Caledonia I turned my attention to the metallurgy of these metals, and began this research with a view to improvements in their extraction, keeping in view the fact that here the reagents usually employed in their extraction are exceedingly expensive.

The sources of nickel, previously to the discovery of these deposits, consisted chiefly of speiss, the residue from the manufacture of smalt, which contains from 6 to 8 per cent of nickel and 3 of cobalt, and a few pyritous ores containing copper and nickel. The details of the processes used for the extraction of the metal from the former are jealously guarded by the manufacturer as trade secrets, but the method adopted is, in general outline, to fuse the speiss with fluor-spar and chalk to remove part of the iron and obtain an enriched matt. This matt is ground, thoroughly roasted, to expel arsenic and sulphur and convert the metals into oxides, which are then dissolved in hydrochloric acid. The solution is diluted with water, any ferrous chloride converted into ferric chloride by a solution of hypochlorite of calcium, and the iron precipitated by the cautious addition of milk of lime, any arsenic being removed at the same time. Sulphuretted hydrogen is then passed into the filtrate to precipitate copper, and from the clear solution cobalt is precipitated by hypochlorite of calcium, and afterwards the nickel by milk of lime.

It seemed probable that the nickel in the New Caledonian ore, occurring as it does in serpentine, might have been deposited from an acid solution percolating through the magnesian rocks, and that if this process could be reversed the nickel might be again obtained in solution. Digestion with ammoniacal solutions of magnesian sulphate and chloride and calcium chloride at various temperatures was therefore tried, but minute quantities only of nickel were dissolved, though in every case distinct traces were obtained.

Trials were made with the view of taking advantage of the comparatively easy decomposition of magnesium chloride by aqueous vapour at a high temperature. The nickel and magnesium were obtained together in solution evaporated to dryness and treated with steam at various temperatures ranging from 212° F. to dull redness, but much nickel chloride was invariably decomposed along with the magnesium chloride.

A portion of the ore in pea-sized pieces was then treated at a dull red heat in a combustion-tube with dry hydrochloric acid gas, with the view of converting the nickel into chloride, whilst the magnesium remained as silicate. Water was freely given off, and the pieces of ore became covered with crystals of anhydrous chloride of nickel. The effect was very beautiful, as the golden-yellow scales of chloride gradually grew out of the ore until each piece seemed converted in a golden ball. The chloride was readily dissolved out by hot water, but numerous trials gave only an average of 3·62 per cent of nickel extracted from an ore containing 10·66 per cent. The solution contained both ferrous and magnesium chlorides in small quantities. Its composition, calculating the metals as dry chlorides, was—

Ferric chloride	traces
Ferrous chloride	5·42
Magnesium chloride	12·45
Nickel chloride	82·13
	100·00

From finely-ground ore, similarly treated for five hours, 6·73 per cent of nickel was extracted, whilst no increase was observed on continuing the treatment for two hours longer.

It seemed, therefore, as if part of the metal was in more intimate combination with the silica than that extracted; so with a view to decompose this silicate different portions of the residue were treated at a red heat with hydrogen, coal-gas, and finely-divided carbon (obtained by mixing starch with the ore), and afterwards roasted to re-convert the reduced metals into oxides. On further treatment with hydrochloric acid gas 1·65 per cent was obtained, still leaving 3·93 per cent. There was little apparent difference between the reducing-agents, although on the whole the carbon seemed the best. The solutions obtained after reduction were much more impure than those got in the first instance, showing more iron than nickel. Calculated as before they contained—

Ferrous chloride	47·36
Magnesium chloride	16·80
Nickel chloride	35·84
	100·00

These results were obtained with a somewhat friable ore containing much ferric oxide, but it was observed that some dense varieties yielded scarcely any chloride of nickel by this method.

When a charcoal chaufer was used for heating the tube, on some parts of it small brilliant black crystals were

* Read before the Royal Society of N. S. W., July 3, 1878.

deposited. These were highly magnetic, and contained ferric oxide and nickel oxide, and probably contained ferroso-ferric oxide with the whole or the greater part of the ferrous oxide replaced by nickel oxide, but sufficient for an analysis was not obtained. They seemed to be formed on those parts of the tube which were over-heated, but some other circumstances contributed to their formation, as repeated trials to obtain them in larger quantities failed.

These experiments, although failing to separate the nickel from the silicate, showed that oxide of nickel could be separated from ferric oxide by treatment with gaseous hydrochloric acid, so the behaviour of the mixed oxides was next examined.

The New Caledonian ore is very infusible, from the large proportion of magnesia it contains, and some cheap flux containing other silicates was necessary to obtain the nickel in a metallic or reguline state. This was found in copper ore furnace-slag, which with half its weight of ore yielded a sufficiently fusible charge. The alloy of iron, nickel, and copper, obtained by fusing with carbon only as a reducing agent, was too tough to grind, and was therefore difficult of conversion into oxides; but the addition of arsenical pyrites readily yielded brittle buttons, which were easily pulverised. Indeed, a piece of arsenious oxide thrust into the fused mass in the crucible gave a similar result, as was also the case with iron pyrites. Thus a mixture of 400 grains, 100 grains mispickel, and 800 grains copper slag gave a button weighing 175·6 grs., and containing 63 grains nickel, whilst the yield should have been 66 grains. Again, 400 grains ore, 800 grains slag, with 50 grains pulverised charcoal being fused, 90 grains of arsenious oxide was thrust into the molten mass, and a button was obtained weiging 271 grains, containing 64·8 grains nickel, showing a loss of only 0·3 per cent of the nickel in the ore. The various buttons were crushed and roasted, and the oxides were treated with hydrochloric acid gas (from which aqueous vapour was partially removed by passing it through a Liebig's condenser) at dull red heat. The whole caked together into a mass from the nickel chloride formed; so, to render it permeable, it was removed, crushed, and re-treated until water ceased to be evolved. With boiling water a solution was obtained containing nearly all the nickel, but at the same time a considerable quantity of ferrous chloride, whilst ferric oxide with traces of nickel remained.

It was evident, therefore, that a more thorough calcination was required to effect the separation of the iron and nickel, but it was difficult to determine when the calcination had been carried far enough, as the presence of copper and nickel obscured the usual reaction for ferrous oxide. It was found, however, that by treating a sample from the muffle with hydrochloric acid until complete solution was effected, cautiously mixing with this solution an equal bulk of sulphuric acid, boiling to expel the hydrochloric acid, and adding to the cooled solution a crystal of potassium nitrate, the characteristic brown colour was rapidly developed as long as ferrous sulphate was present.

As speiss was actually the substance under treatment, it was thought advisable to examine the behaviour of the other oxides which are generally contained in it. A speiss was therefore made with ore and various residues, and after calcination was found to contain 41 per cent of oxide of nickel with the oxides of iron, copper, zinc, cobalt, and arsenic. These oxides, treated as before, yielded in a flask attached to the outlet a solution containing arsenic and zinc which had been volatilised as chlorides, and the residue on boiling with water a solution containing nickel and cobalt with a small quantity of iron. The insoluble residue contained the ferric oxide, a small quantity of nickel oxide and copper as cuprous chloride, which could be removed by a solution of salt.

It now remained to separate the small quantity of iron in the solution from the nickel and cobalt and these metals from each other, and it seemed desirable to do so without adding fixed reagents. It was found that this could be done by passing chlorine into the solution until all the iron was in the form of ferric chloride, and then adding to the boiling solution successive small portions of anhydrous oxide of nickel, which dissolved, precipitating the iron as a basic chloride. The precipitate was dense, and contained a small quantity of oxide of nickel added in excess. From a neutral solution containing ferrous chloride it was also found that manganese dioxide completely precipitated the iron without a trace of nickel or cobalt.

On adding to the hot iron free solution rather more oxide of nickel than was equivalent to the cobalt present, and passing chlorine into it, the whole of the cobalt was precipitated as cobaltic oxide, and a pure green solution of chloride of nickel obtained. This solution, evaporated to dryness and ignited in a current of steam, evolves hydrochloric acid, and leaves oxide of nickel, which may

CALCINED SPEISS CONTAINING OXIDES OF NICKEL, COBALT, COPPER, ZINC, IRON, ARSENIC.

I. Treated with Gaseous Hydrochloric Acid gives—

Distillate. — Containing zinc and arsenic.

Residue. — Containing ferric oxide, cupreous chloride, ferrous chloride, nickel chloride, cobalt chloride, with traces of nickel and cobalt oxides.

II. Treated with hot water gives—

Residue. — Containing ferric oxide, cupreous chloride. Traces nickel & cobalt. Treated with brine gives solution of cupreous chloride, from which copper precipitated by iron. Residue, other metals, returned to melting-furnace.

Solution. — Containing ferrous, nickel, and cobalt chlorides.

III. Treated with chlorine till all ferrous converted into ferric chloride, and then boiled with oxide of nickel.

Precipitate. — Ferric oxide and oxy-chloride, with the excess of nickel oxide. Returned to roasting-furnace.

Solution. — Containing chlorides of nickel and cobalt.

IV. Treated with chlorine in presence of oxide of nickel.

Precipitate. — Cobaltic oxide and excess of nickel oxide added. Treated with dilute hydrochloric acid.

Solution. — Pure nickel chloride evaporated to dryness, and ignited in current of steam.

Residue. — Cobaltic oxide.

Solution. — Nickel chloride.

Gas. — Hydrochloric acid returned to I.

Residue. — Oxide of nickel to reducing furnace.

be reduced in the usual manner. The chloride could also be reduced directly to metallic nickel by igniting in a current of hydrogen; and in the case of a solution containing manganese this would be advantageous, as its chloride is not reduced by hydrogen, and could be separated from the nickel by washing.

The precipitated cobaltic oxide was suspended in water and treated with chlorine at the boiling-point, whilst small quantities of chloride of cobalt were added until cobalt remained in solution. All the nickel was thus removed from the precipitate to the solution, which contained also the cobalt added in excess. The same result could be obtained by digesting the precipitate with dilute hydrochloric acid, which would dissolve the nickel only.

Attached is a scheme which shows the process at a glance, with the destination of the intermediate products; and, although somewhat complicated, it must be remembered that six metals have to be separated, and that two of these—nickel and cobalt—are perhaps the most difficult of all metals to separate satisfactorily. The separation is, moreover, effected without having voluminous precipitates, such as ferric and nickel hydrates, four or five ounces of which occupy a cubic foot of space, to treat and wash, whilst the reagents used are in great part recovered in an available form. It is scarcely necessary to observe that if the number of metals present is reduced the treatment would be correspondingly shortened and simplified.

PROCEEDINGS OF SOCIETIES.

UNIVERSITY COLLEGE CHEMICAL AND PHYSICAL SOCIETY.

THIS Society has lately transacted the follow business:—

Thursday, October 17, 1878.—Dr. OLIVER J. LODGE, President, in the Chair.—President's retiring address, "*On the Importance of Experimental Research and the Necessity for its Endowment*," by Dr. LODGE.

Thursday, October 31, 1878.—Dr. C. A. BELL, B.A., President, in the Chair.—Paper on "*Volumetric Analysis*," by Dr. BELL.

Thursday, November 14, 1878.—Dr. C. A. BELL, B.A., President, in the Chair.—Papers on "*Catalysis*," by C. W. WATTS; and on "*The Estimation of Nitrous Acid*," by C. J. WILSON.

The next meeting will be held on Thursday, December 12th, at 7 p.m., when the following papers will be read:—"On Liebig and his Influence on the Progress of Modern Chemistry," by J. Sakurai; and "On a Colorimetrical Process for the Estimation of Nitric Acid," by Charles E. Cassal.

NOTICES OF BOOKS.

Animal Chemistry, or the Relations of Chemistry to Physiology and Pathology. By C. T. KINGZETT, F.C.S. London: Longmans and Co.

STRANGE as it may seem, the author of this work is fully justified in his complaint that animal chemistry is neglected. A certain number of facts relating to blood, bile, and urine have indeed been accumulated, and are duly instilled into all medical students as a necessary preparation for what is gradually being recognised as the whole duty of man—to wit, "passing." But how little has been done towards co-ordinating these facts, exhibiting them in their natural order of sequence! Text-books are doubtless compiled, but how? The condemnation of one of the most recent could not be better expressed than has been done by our author in these few pregnant words:—"In a third and even more modern treatise, by Prof. Karl B. Hofmann, more space is devoted to 'nuclein'—an impure ordinary albuminoid—than to the whole brain chemistry, while eight pages are devoted to the structural formula of glycerin." Even Liebig, great as have been his merits in the field of physiological chemistry, can scarcely be held guiltless of the charge brought against him by Henlé:—"With consummate skill he (Liebig) draws a few crystalline threads out of the tissue of life, and holds them up to admiration as the share of chemism; he then throws us the lump which he cannot unravel as the share of vitalism." Such being the state of this department of science, our author's object has been "to collect and systematise, as far as could be, all the trustworthy work on record in relation to animal chemistry, so far as it concerns the human body." It has been no part of his undertaking to furnish an encyclopædia of facts, nor to describe well-known processes of zoochemical analysis, but to exhibit, "in as natural an order as possible, all those parts of the subject which, when properly arranged, present something like a system."

To this difficult and complicated task Mr. Kingzett has brought the special qualification of having devoted four years to successful research in this branch, and the result, we fear not to say, is the most valuable treatise on animal chemistry which has appeared since the memorable work of Liebig. The author's point of view, if we misunderstand him not, is scarcely that of a vitalist. Thus, in referring to the valuable and interesting researches of his collaborateur Dr. Hake, he writes:—"He believes that the chemical changes as they occur in the blood-system, and comprised in the act of oxidation, do not result in the evolution of heat, but force, which becomes electric by the agency of the blood corpuscles, and it is certain that this is perfectly consistent with what we know of cell-life. On this hypothesis the blood-cells form chains and conductors for the electric force thus generated, and this is subsequently metamorphosed into heat at every point of the system. On reaching the cerebro-spinal centres it becomes vital force,—another name for electric force,—and this becomes eventually heat, namely, when it is transmitted to enable the consummation of a vital act, such as sensation, &c. The experiments of Du Bois Reymond, in particular, go to prove that nerve force is only electric force manifested through media not met with out of living bodies. Of course on Hake's hypothesis nerve force is derived from the common centre, the brain, where it is stored in the grey matter of which the brain is partly composed, and from which nerve-tubes spread everywhere. He even goes further, and reasons that when this cerebro-vital force is united in action within the same organic medium with other forces influencing us from without, viz., light, sound, heat, &c., new results are obtained, and phenomena of sense and intelligence are observed. In anæmia the brain loses somewhat of its vital force, the power of attention is diminished, forgetfulness obtains, the faculties are slowly exercised, and why? Because the source of vital force, viz., blood oxidation, is interfered with. The nature and sources of the mind must be considered with Dr. Hake as the grandest problem of science. Sharing this impression, and entertaining the rational hope that even in this direction conclusions are within the attainment of future science, we have given so much attention to Dr. Hake's theory." Our author evidently, therefore, does not share the opinions of Du Bois Reymond, who, in his justly-celebrated discourse on the "Boundaries of our Knowledge of Nature," argues that consciousness, like matter and space, is an ultimate fact, inexplicable even to the hypothetical spirit of La Place. The passage we have just quoted, taken in conjunction with certain denunciations of the "dogmatism of churches," will doubtless be taken in some quarters as an unqualified avowal of materialism. Such an inference will be of doubtful legitimacy—a consideration which will not prevent it from being

drawn. Without denying that the development of science has met with opposition from religious bodies, we cannot forget that men of sufficiently heterodox views in theology —we could point out such by name—are now earnestly labouring to create additional difficulties in certain spheres of research, animal chemistry not excluded.

After certain general considerations in which occur not a few most valuable ideas, not unmixed with views which we should pause before accepting, the author enters upon the examination of the chemical principles and eductsof the body. Here, *inter alia*, he points out the erroneous character of the vulgar notion that the animal function, as contradistinguished from the vegetable, is mainly or entirely one of synthesis, and he shows that most complicated acts of synthesis go on in the animal body itself.

In the second part of the work Mr. Kingzett discusses the organs, fluids, and processes concerned in digestion. In the third he treats of work and waste, introducing into the chapter on animal heat, vital force, and muscular action those daring speculations on the origin and nature of the mind which we have already quoted.

Part fourth is mainly devoted to that most important but difficult question, the chemistry of the brain. The components of this organ, as far as ascertained, and the methods for their separation, are given in some detail. The speculations of Dr. Thudichum and the writer on the "*labile equilibrium*" of the brain, and on the conditions of softening of the brain and of *delirium tremens*, are most interesting, and contain at any rate a nucleus of truth well worth experimental development. In dealing with the question what becomes of alcohol after its introduction into the system, he proposes an experiment which would be instructive, viz., administering large quantities of alcohol to horses intended to be killed, and distilling their brains, removed immediately after death. Perhaps, however, this might be pronounced "vivisection"—a term which seems destined to include any act soever done to an animal, with a scientific purpose in view.

The fifth and last part includes a chapter on "character"—in our opinion doubtfully relevant, though it contains declarations amply sufficient to refute those charges of materialism which will be brought against the author; a discussion of the rival theories of fermentation and putrefaction; of spontaneous generation; of the germ-theory of disease; and of antiseptics and disinfectants.

Mr. Kingzett sees nothing mutually inconsistent in the doctrines of Liebig and of Pasteur, and shows that the younger *savant* has merely advanced on the hypothesis of the older. The question of Abiogenesis he is content to leave undecided, whilst pointing out that the balance of evidence is in favour of the doctrine *Nihil vivum nisi ex vivo*. Space has not allowed us to enter upon an examination of the numerous interesting questions which are here either openly raised or at least suggested, whilst for numerous passages well worthy of quotation we must refer to the book itself.

As a sequel we find a list of "suggested matters for research," and a copious index of authorities. Every medical student and every practitioner who looks to something higher than a mere routine practice should study this book. Nor is it without its claims on the attention of the biologist, and still more of every scientific chemist who has time and opportunity for research.

The Geological Record for 1876. An Account of Works on Geology, Mineralogy, and Palæontology published during the Year, with Supplements for 1874 and 1875. Edited by W. WHITTAKER, F.G.S. (of the Geological Survey of England). London: Taylor and Francis.

THIS record, though of little interest to the general reader, ought to be considered a treasure by geologists and by students of other branches of science who may have occasion to make use of geological data. An examination of the list of transactions, journals, and independent works which have been abstracted in order to compile this volume ought to satisfy every one at once of the labour that has been expended and of the value of the result. We can therefore most cordially second the remark with which the editor closes his brief preface:—"Every geologist should act on the advice of Poet Close, and 'buy a copy of our little book.'"

As a fault—not of the editor's, but of geological explorers—we must again point out that so little work is done in Africa, Australia, &c., where even economical consideration should be a powerful stimulus to exertion. The observation recorded on p. 162, that "there never has been a Glacial epoch in New Zealand, and consequently none in the Southern Hemisphere," is, if confirmed, of the highest importance.

New Weekly Journal for the Oil and Fat Trade (Neue Wochenschrift für den Oel und Fettwaarenhandel). Jahrgang II., Nos. 43 and 46.

THIS journal represents the German oil-trade and the branches of industry therewith connected. The question of a duty on the importation and manufacture of petroleum in Germany is discussed at some length, and in addition we find a notice of the Gallician oil-wells, a paper on the oils employed in the arts and their applications, besides a great body of statistics and market-reports.

The Speaking Telephone and Talking Phonograph, and other Novelties. By GEORGE B. PRESCOTT. Fully illustrated. New York: D. Appleton and Co. 1878.

MR. PRESCOTT is already favourably known, both in this country and America, as the author of an excellent Manual of Electricity and Telegraphy; but we are sorry to say that the present work, although valuable in its way as a record of facts, is not calculated to add to his reputation as a scientific writer. It consists, for the most part, of verbatim reprints of most of the papers on Telephony and kindred subjects which have been read before the different scientific societies of England and America during the last two or three years, loosely strung together and interspersed with a few remarks from the author. These papers are printed in the same type as the original matter, and, as inverted commas are placed only at the beginning and end of each of them, it is often difficult to know whether it is Mr. Prescott or some one else that is speaking in the first person without referring back several pages. The very introduction itself is confused by the reprint of a speech delivered by one of the counsel at a recent telegraphic trial in New York. It is a very meagre account of the history of electrical discovery, which we cannot agree with Mr. Prescott in thinking either "interesting" or "valuable," seeing that exactly fourteen words are devoted to Faraday's discoveries in magnetic induction.

The first chapter is original, and gives us a clear and succinct account of the principles of sound; Reiss's musical telephone, and Gray's improvements on it; Gray's, Bell's, and Dolbeau's articulating telephones, and Phelps's duplex telephone—the latter a very beautiful piece of apparatus, as far beyond Bell's trumpet-shaped instrument as a modern Westley Richards' central fire breech-loader is beyond a Joe Manton. The same remarks apply to Gray's latest form of instrument, in which a horse-shoe magnet is used in conjunction with a double set of vibrating diaphragms, the magnet forming the handle of the apparatus. We regret that we cannot give our readers a description of these very ingenious instruments without a number of diagrams; we can only refer them to Mr. Prescott's book. Edison's carbon disk telephone is also described, but the book appears to have been published too early in the year to have included any account of the

microphone. The chapter concludes with an extract from Baille's "Merveilles de l'Electricité," published in Paris in 1871, in which the realisation of the idea of a speaking telephone is strongly foreshadowed by the author.

Chapter II. consists of the papers read by Prof. Bell, in October last, before the Society of Telegraphic Engineers, with a few notes by Mr. Prescott.

Chapter III. is made up of articles from the *Westminster Review*, *Engineering*, and *Chambers's Journal*.

Chapter IV. is a hotch-potch from various sources, such as *Silliman's Journal*, *Poggendorff's Annalen*, De la Rive's "Electricité," &c., on the production of sounds by electricity.

Chapter V. consists of Mr. Elisha Gray's papers on Telephonic Researches, read before the American Electrical Society, and contributed to their *Transactions*. At the end we find both Mr. Gray's and Prof. Bell's original specifications, as filed by them at the New York Patent Office on the same day, *i.e.*, February 16th, 1876, by which it would appear that, on paper at least, Mr. Gray was the first discoverer of a telephone which would transmit articulate sounds. Mr. Gray, however, states that it is not his intention to raise the question of priority of invention as between himself and other parties. As Mr. Gray does not seem to wish to assert any rights in the matter, the question may very well be allowed to rest where it is, referring those of our readers who are interested in the subject to Mr. Prescott's book.

Chapter VI. contains an account of Mr. T. A. Edison's telephonic researches from his own pen, giving a most interesting account of his various discoveries and inventions, apparently written expressly for Mr. Prescott's work. Chapter VII. is a history of electro-harmonic telegraphy, read by Mr. F. L. Pope before the American Electrical Society in December last. Chapter VIII. consists of an abstract from a paper by Professor Dolbear, entitled "Researches in Telephony," in which he definitely claims to have been the first person to use a permanent magnet for vibrating the disk of a telephone.

In Chapter IX. Mr. Prescott once more resumes his task, and lucidly describes the improvements made in telephonic instruments by Messrs. Blake, Peirce, Channing, and others, in which he claims for the latter physicist the invention of the first portable telephone. Before this interesting chapter is ended, however, Mr. Prescott once more relapses into the "scissors and paste" style of literature, and gives an abstract from a paper of Dr. Channing's and a translation of Count du Moncel's account of the telephone read before the French Academy. Chapter X. is on the Talking Phonograph, and is almost entirely written by Mr. Prescott. The prophecies as to what Mr. Edison's invention will accomplish in the future, and the extract from a particularly popular article in *Scribner's Monthly*, is hardly worthy of a place in a serious scientific book.

As a piece of scientific exposition, Chapter XI., on Quadruplex Telegraphy, is undoubtedly the best in the book, and is a tantalising proof of Mr. Prescott's ability to treat of such subjects. It is certainly the most thorough description of the wonderful improvements which have lately been made in multiplex telegraphy which we have yet met with. It is a branch of telegraphy in which Mr. Prescott seems to be perfectly at home, and he evidently writes *con amore*. Would that he had done so in the other parts of the book. The same praise may be extended in a minor degree to the less important subjects—electric call bells and the electric light—which receive attention in the two last chapters of the book. The last subject might, however, have been treated of at greater length, seeing the attention it is attracting in London and Paris. We should have been glad, for instance, to have heard more of Mr. Farmer's method of obtaining a number of lights from a single source by using thin strips of platinum or iridium, and raising their temperature to a point slightly below that of melting.

The Index is far too small for a work containing so much matter.

It is with a feeling of disappointment that we rise from the examination of Mr. Prescott's book. In the chapters which are due to his pen alone he proves to us with what lucidity he can treat a scientific subject. Had he only taken the various and unquestionably valuable papers which he reprints, and reproduced them after having mentally assimilated them in his own brain, we should have had a work of high value and surpassing interest, and the student would not have been compelled to waste time or patience in separating the useful metal from the mass of rough ore with which Mr. Prescott presents us. The principles of sound and musical vibrations, for instance, are explained over and over again, and detail after detail is repeated *ad nauseam* in nearly every one of the papers given; we are afraid to say, for instance, how many times Bell's telephone is described in different parts of the book.

We make these somewhat severe remarks in the most friendly spirit, as a proof of which we shall conclude by expressing a fervent wish that Mr. Prescott's book will sell with such excessive rapidity that a new edition will very shortly be a necessity, when we hope to have a specimen of what we already have the fullest proof of what the author can do, and we trust will do, in giving us a history of the telephone and its electrical congeners.

The work contains over two hundred woodcuts, most of them of great beauty, and many of them beyond anything that has been accomplished by our English wood engravers in the way of scientific illustration. Mr. Prescott also adopts the excellent plan of repeating a cut whenever it is necessary instead of worrying the reader by frequent cross references. The general "get up" of the book is fully worthy of the reputation of the firm by which it is issued.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 20, November 11, 1878.

Vision of Colours, and especially on the Influence Exercised on the Vision of Coloured Objects moving circularly when Observed in Comparison with Stationary Objects Identical with the Former.—M. E Chevreul.—The author treats of the vision of material colours in motion, under which head he refers to the principles of mixture and contrast; of variations of tone according to the brightness of the day, which, as is shown, exercises a decided influence on the result of the experiments; and of the differences of tone and of colour in consequence of difference of speed, from the swiftest to total repose.

The Expansion of Heated Bodies and the Pressure which they Exert.—M. de Sainte-Venant.

Energy of a Body and its Specific Heat.—M. R. Clausius.—Two mathematical papers, not admitting of useful abstraction.

Measure of Magnifying Power in Optical Instruments.—G. Govi.—It is inexact to say that such a lens or such a microscope magnifies the image of objects a certain number of times without adding at what distance must the image be in order to realise such an enlargement.

Possibility of Obtaining by Means of Nitrous Oxide Insensibility of Long Duration, and on the Harmlessness of this Anæsthetic.—P. Bert.—The author administers a mixture of equal volumes nitrous oxide and atmospheric air at a pressure of two atmospheres.

Observations on M. Maurice Levy's Memoir on a Universal Law Relating to the Expansion of Bodies.—M. Massieu.—M. Levy's proposed law is only applicable to bodies in which the internal work depends merely on the volume, whilst the specific heat for equal volumes depends solely on temperature.

Anilised Derivatives of Sebasic Acid.—E. Maillot.—The action of a temperature of 150° upon equal weights of sebasic acid and of aniline produces sebanilide, a neutral compound soluble in absolute alcohol at a boiling temperature, and sebanilic acid, soluble even in the cold in alcohol of 90 per cent, and especially in ether. It is monobasic, and forms salts.

Artificial Crystallisation of Orthose.—M. St. Meunier.—The author has arrived with orthose at a similar result to those which MM. F. Fouqué and Michel Lévy have obtained in the devitrification of oligoclase, labrador, and albite, previously converted into glass by fusion.

Theory of Machines Like that of Gramme.—Ant. Breguet.—If it is desired to obtain the best possible effect from a system constituted by a movable circuit animated by a rotatory movement in a magnetic field; then, if this movement is caused by the passage of a current from a foreign source, the diameter of the points of contact should be displaced in the inverse direction of the rotation, by an angle so much the greater as the intensity of the current is more considerable, and the intensity of the magnetic field more feeble. If this movement is destined, on the one hand, to produce a continuous current in the apparatus, the same diameter ought to be displaced in the direction of the rotation.

Chemical Researches on the Tungstates of the Earthy and Metallic Sesquioxides. Third Memoir.—J. Lefort.—In the tungstates of sesquioxides the proportion of acid to base varies almost in every metal. The author has examined the tungstates of alumina, iron (ferricum), chrome, uranium, antimony, and bismuth, and subjoins their formulæ.

Analysis of Certain Metallic Fragments from the Peruvian Sepulchres of Ancon, near Lima.—A. Terreil.—The author has examined five samples of metallic fragments obtained from Peruvian tombs, dating, it is supposed, from the middle of the sixteenth century.

Synthesis of the Uric Derivatives of the Alloxan Series.—E. Grimaux.—The author has obtained artificially alloxan, uramile, and murexide, synthetically. He heats to 150° a mixture of malonic acid and urea with excess of phosphorus oxychloride, and obtains a yellow mass consisting of two amorphous bodies, sparingly soluble in water, which appear to be condensation-products of malonyl-urea, and which are easily transformed into alloxantine, alloxan, uramile, &c.

Some Causes of the Inversion of Cane-Sugar, and on the Consecutive Changes of the Glucoses formed.—M. Dur.n.—The inversion of sugar under the combined action of water and heat is a chemical phenomenon which acquires intensity when the solutions are neutral or acid and which is suspended by alkalinity.

Presence of the Alcoholic Ferment in Air.—P. Miquel.—If in September and amidst the vineyards of southern France sterilised grape-juice is exposed to the air in vessels freed from all germs, it enters into fermentation in a few days, whilst similar experiments at Paris and in the park of Montsouris have invariably given a negative result.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin. No. 12, 1878.

Investigations on Pinakons and Pinakolins. (Third Memoir).—W. Thörner and T. Zincke.—The authors describe *a*-benzpinakolin, a compound formerly obtained by the oxidation of tetra-phenyl-ethylen, and known as tetra-phenyl-ethylen oxide.

On Styrolen Alcohol or Phenyl-glycol. (Third Memoir).—A. Breuer and T. Zincke.—The authors have performed a series of experiments in order to ascertain if two isomeric alcohols can be derived from styrol. The experiments yielded only the alcohol already known, except that in one case a small quantity of a body was obtained, which may possibly be the second alcohol.

A Hydrocarbon from Styrolen Alcohol.—A. Breuer and T. Zincke.—The hydrocarbon in question crystallises from hot alcohol in fine shining leaflets, fusible at 101° to 101·5°. It is readily soluble in ordinary solvents, disti without undergoing decomposition, boils at 345° to 346°, and if acted upon by chromic acid yields a well-characterised quinon, which is described at length.

Action of Thionyl-chloride upon Aniline.—C. Böttinger.—The reaction is violent, sulphurous acid being evolved and aniline hydrochlorate deposited, along with a body not yet examined.

Action of Thionyl-chloride upon Benzol.—C. Böttinger.—Hydrochloric and sulphurous acids escape, whilst a dark resinous body remains.

Electrolytic Determination of Mercury.—F. W. Clarke.—A solution of mercuric chloride slightly acidulated with sulphuric acid was put in a platinum capsule connected with the zinc pole of a Bunsen bichromate battery of six elements. The wire at the end of the carbon pole terminated in a thin slip of platinum foil, which plunged into the solution. At first mercurous chloride was deposited, which gradually took the metallic state, and after the lapse of an hour there was nothing in the capsule but a pure mass of mercury, covered with a solution in which ammonia occasioned not the slightest turbidity. This liquid was withdrawn with a pipette, and water poured in its place a time or two before separating the connection with the battery. The liquid was then decanted off and the mercury washed first with water, then with alcohol, and lastly with ether, and was then dried under the air-pump.

Chlorine Compounds of Naphthalin.—E. Fischer.—A reply to H. A. Atterberg's paper (*Berichte*, xi., Heft 10).

Undecylenic Acid.—F. Becker.—An account of experiments made with the newly-discovered member of the oleic series, obtained during the dry distillation of castor oil.

Undecolic Acid.—F. Krafft.—This acid, $C_{11}H_{18}O_2$, is a product of undecylenic dibromide heated in closed vessels with alcoholic potassa.

Remarks on the Memoir of H. H. W. Vogel "On the Diversity of the Absorption-Spectra of One and the same Body."—James Moser.—The author contends that not only every compound but every solution has its own spectrum.

Azo-benzol-acetic Acid and its Homologues.—J. Züblin.—A notice of some of the salts and other derivatives of this acid, and of its homologues.

Oxidation-products of β-Hexyl-iodide, Hexylen-bromide, and Mono-bromo-hexylen from Mannite.—Otto Hecht.—The author concludes that in the oxidation of the halogen compounds of hydrocarbon radicals the halogen is separated out, and the atoms of carbon formerly combined with it are converted into COOH.

Appendix on Corallin and its Components.—K. Zulkowsky.—This paper refers mainly to an essay on formation of crude corallin, by P. Gukassianz (*Berichte*, xi., p. 1179).

Production of Benzol from the Tar-Oil of Lignites. MM. Salzmann and H. Wichelhaus.—An investigation of the manner in which the benzol in question may originate.

On Dioxy-benzo-phenon from Rosanilin.—C. Liebermann.—Remarks on a paper by MM. Caro and Græbe. (*Berichte*, xi., p. 1348).

Penta-halogen Compounds of Resorcin and Orcin.—H. Claassen.—The author has succeeded in showing in a great number of reactions that of the five halogen atoms of penta-brom-resorcin, penta-brom-orcin, and penta-chlor-resorcin, three which are substituted behave differently from the other two which are added.

On Diastase.—M. Baswitz.—The author concludes that the saccharific action of diastase is accelerated by carbonic acid. In the presence of this acid a larger quantity of sugar is formed than in its absence. In either case the maximum of saccharification sets in after from two and a half hours to four hours even in presence of an excess of starch.

Nitro-derivatives of Hydroquinon.—R. Nietzki.—If diethyl-hydroquinon dissolved in acetic acid is added to fuming nitric acid there is formed a mixture of di- and tri-nitro-derivatives. If a more dilute acid is used, on the one hand, or sulpho-nitric acid, on the other, either of these products may be obtained separately.

On Styrol.—W. v. Miller.—The author undertook to separate styrol from accompanying substances by converting it into the crystallised bromide.

Action of Sodium Amalgam upon Nitro-para-toluidines in Alcoholic Solutions.—E. Buchney.—The author describes azoxytoluydin and its reduction-products, azotoluydin and hydrazotoluydin.

Coloured Derivatives of Pyrogallic Ether.—A. W. Hofmann.—The author treated the secondary ethers of pyrogallic acid with crystalline sesquichloride of carbon (C_2Cl_6). If the dimethylic ether is mixed with so much alcoholic solution of potassa as is required for the formation of its potassic salt, and sesquichloride of carbon is then added in such quantity that the chlorine exactly suffices to convert the potassa present into potassic chloride, and the mixture is heated for six to eight hours to about 130° preferably in a sealed tube, the liquid takes a deep indigo-blue colour. This liquid is freed from alcohol by evaporation, the residue dissolved in water, any excess of carbon sesquichloride removed by filtration, and the liquid mixed with hydrochloric acid. The blue colour changes to a light rose. The substance when purified forms yellow crystals which form blue salts with bases. It is probably identical with the substance obtained by Grätzel from beech-wood tar, and known as eupitton, and with Reichenbach's pitakall.

Constitution of Dioxy-benzol.—H. Fischli.—The nature of this paper will appear from the title. The author examines the mutual behaviour of platinic chloride and guajacol.

Chemiker Zeitung.
No. 44, 1878.

Discovery of the Manufacture of Artificial Ultramarine.—Dr. E. Büchner.—The author gives in full a paper by Gmelin, extracted from the *Naturwissenschaftlichen Abhandlungen* for the year 1828. In this document Gmelin states that he had turned his attention to the artificial preparation of ultramarine as early as 1826, and in the spring of 1827, whilst on a visit in Paris, had communicated his ideas to Gay-Lussac and to his friend Robinet, who both recommended him to keep the matter secret. He was, therefore, much surprised on learning that on Feb. 4th, 1828, Gay-Lussac announced to the Academy of Sciences that the synthesis of ultramarine had been effected by Guimet. Dr. Büchner accuses Guimet of having appropriated the discovery of another, and hints that he may have had accomplices.

Examination of Dynamite.—The method proposed is lixiviation with ether, which dissolves the nitro-glycerin, leaving the infusorial earth untouched.

Terra di Siena.—Dr. F. Matthey announces the discovery of a deposit of this pigment in the Erzgebirge.

Inferior Superphosphate.—The Agricultural Station of Halle announces that a commission house in Germany is selling superphosphate of English origin, prepared from coprolites and phosphorite, which strongly resembles in colour the favourite superphosphate made from Mejillones guano, and which the writer seems to suspect is used for fraudulent purposes.

Bolivian Nitrate of Soda.—The monopoly established by the Peruvian Government has given a great stimulus to the nitre trade of Bolivia. From May 15th to June 16th 1,177,600 kilos. have been shipped from Antofagasta alone.

Pictet's Artificial Ice Company now sells ice in New York at one dollar per ton.

Quantitative Determination of Starch in Paper.—C. Wurster.—The author first determines the moisture, then the resin by boiling with alcohol to which a few drops of hydrochloric acid have been added. He then extracts the starch by prolonged boiling in equal parts of alcohol and water also acidulated with hydrochloric acid, and then weighs the residual paper. The action of the hydrochloric acid occasions a loss of mineral constituents. Hence the ash must be determined both in the original and in the extracted paper, and the difference, which is almost constant, and amounts to 0·8 to 1·1 per cent, is deducted from the starch.—(*Dingler's Polyt. Journal.*)

Preparation of Hydrogen Gas.—H. Kollmann.—Hydrogen is easily obtained by treating ferro-manganese with dilute sulphuric acid. The gas thus obtained is not merely adapted for ordinary laboratory purposes, but also for Marsh's arsenic test.

Detection of Free Tartaric Acid in Wine.—Professor Claus evaporates to a syrup, and agitates with ether. If free tartaric acid is present the ether leaves on evaporation a crystalline deposit, which, if dissolved in water, gives, on the addition of an alcoholic solution of potassic acetate a precipitate of tartar. The author proves the solubility of tartaric acid in ether, which is denied in most text-books.—(*Polyt. Notisblatt.*)

Iridescent Glass.—Glass is rendered iridescent by exposing it when very hot to the fumes of stannic chloride, to which barium- or strontium-nitrate is added if deep colours are required.—*Polyt. Notisblatt.*

Atropin and Daturin. –According to Planta these bases, which were formerly supposed to be identical, are chemically distinct. Atropin is optically inactive, whilst daturin turns the plane of polarisation to the left. Platinum chloride precipitates the salts of atropin, but not those of daturin. On the other hand, picric acid precipitates daturin only.—*Pharm. Central Halle.*

New Volumetric Method for the Determination of Zinc.—C. Mann converts the zinc into chloride and mixes with a few drops of a concentrated solution of iron-ammonia alum, and with an excess of standard silver-nitrate. By titrating back with ammonium sulpho-cyanide till a faint redness is remarked, the excess of silver is ascertained, and consequently the quantity of silver used to precipitate the chlorine, and by reducing the latter to zinc the amount of this metal is known. The zinc is converted into chloride as follows:—It is dissolved in nitric acid mixed with ammonic acetate, sulphuretted hydrogen gas is passed through the solution, and the precipitate, after boiling and twice decanting, is filtered. The precipitate, along with the filter, is placed in a beaker mixed with about 50 c.c. of water and an excess of well-washed silver chloride, and boiled till the liquid becom

perfectly clear. The precipitate, a mixture of silver sulphide and excess of silver chloride, is easily washed. When this is complete the filtrate is acidulated with nitric acid, and treated as above.

Impurities of Commercial Nickel.—The nickel met with in commerce contains up to 8 per cent cobalt and 12 per cent copper, besides small quanties of iron, arsenic, zinc, manganese, sulphur, carbon, silica, and alumina. —*Metall-Arbeiter.*

New Reagent for Carbolic Acid.—Four or five drops of a solution of 1 part of molybdic acid in 10 to 100 parts of concentrated sulphuric acid are added to one or two drops of the liquid under examination, in a porcelain capsule. If carbolic acid is present a light yellow or yellowish brown colour appears, which changes to a chestnut-brown, and finally to a fine purple. The liquid to be tested must be dilute.

Detection of Indican in Urine.—Thirty c.c. urine are mixed with an equal volume of fuming hydrochloric acid in a test-tube holding 80 c.c., and warmed gently over the lamp. The addition of one or two drops of nitric acid makes the test more sensitive. The mixture, which has a brown colour, is cooled by dipping the glass in cold water, covered with 2 or 3 centimetres of ether, and well shaken. If indican is present, the ether, when the liquid has become clear, will be found covered with a blue scum of indigotin. The subsequent addition of a few drops of alcohol renders the reaction more sensitive. —*Arch. Pharm.*

No. 45, November 7, 1878.

In an article on sulphur and its products by Dr. Deite, it is stated that in 1875 the total yield of sulphuric acid in Europe amounted to 841·25 million kilos., of which 500 millions fall to the share of England, 150 millions to France, 106·25 millions to Germany, 40 millions to Austro-Hungary, and 30 millions to Belgium.

A college has been opened at Litten for the study of the theoretical principles of the art of distilling.

The yield of mercury in California for the present year is estimated at 8000 bottles of the value of 2½ million dollars.

A sarcastic account is given of the recent exhibition of gas-fittings, &c., at Wolverhampton. It is said that some of the exhibitors refused the medals offered them on account of the incompetence of the judges, one of whom did not even know what a Bunsen burner was.

The mercury mines of Almaden in the Sierra Morena have produced in the last three centuries 120,179 tons of mercury, of the value of 1,440,005,000 francs.

Dr. J. S. Meyer has, it is rumoured, re-discovered the lost Egyptian art of hardening copper so as to bear a cutting edge.

The cultivation of the castor oil plant in the state of Illinois is very important, the county of St. Clair alone producing yearly 300,000 gallons.

According to the *Photograph. Zeitung* chloride of silver is decidedly soluble in concentrated hydrochloric acid.

Determination of Nitric Acid in Spring Water.—Eder recommends for this purpose Tiemann's method as the best. This consists in evaporating down 1 litre at 150°, extracting with water, decomposing the filtrate with hydrochloric acid and ferrous chloride, boiling and receiving the escaping nitric oxide over soda-lye for measurement. Wagner's method is also applicable. It consists in destroying the organic matter with permanganate in a boiling alkaline solution, evaporation to dryness of the liquid previously freed from alkaline earths and from any oxalic acid which may have been formed, heating the residue mixed with soda and chromic oxide in a current of carbonic acid. The quantity of nitric acid is inferred from the quantity of chromic acid formed. This process cannot be recommended where nitrates are mixed with a large excess of organic matter.—*Zeitschrift Anal. Chemie*

Incineration of Flour.—The sample is mixed with pure crystallised ammonic nitrate, heated to ignition, withdrawn from the lamp, and allowed to deflagrate. The process is repeated till all carbonaceous matter is destroyed. —*Zeitschrift Anal. Chemie.*

Sensitiveness of Reactions for Hydrocyanic Acid.—Sulphocyanide test, 1 : 4,000,000 ; guaiacum copper, 1 : 3,000,000 ; silver test, 1 : 250,000 ; iodide of starch, 1 : 250,000 ; prussian blue, 1 : 50,000.—*Zeitschrift Anal. Chemie.*

New Acidimetric and Alkalimetric Indicator.—Fresh cut orange-peel is digested for twenty-four hours in a little alcohol ; the volatile oil is removed from the yellow solution by treatment with ether and separated off. The tincture on dilution with water yields a colourless liquid, which is coloured yellow by alkalies and is not affected by acids. It gives accurate results in presence of ammoniacal salts.—*Zeitschrift Anal. Chemie.*

Valuation of Zinc-Powder.—To determine the metallic zinc present—the only valuable constituent—Fresenius mixes about 3 grms. of the powder in a flask with sulphuric acid, and passes the hydrogen gas evolved through refrigerating and desiccating tubes into a combustion tube filled with cupric oxide. The water formed is absorbed in a U-tube two-thirds full of broken glass and containing 12 c.c. pure concentrated sulphuric acid. Nine parts of water correspond to 32·53 parts of metallic zinc.—*Zeitschrift Anal. Chemie.*

New Method of Determining Melting-Points.—Carnelly places the substance (especially metallic salts) in a weighed platinum crucible, heats it over a Bunsen burner or blast, and as soon as the salt melts places the crucible in water, the weight and temperature of which are known. The increase of temperature in the water is observed, and by the aid of the equation for the specific heats the temperature of the crucible is found as the salt began to melt.—*Zeitschrift Anal. Chem.*

Supersaturated Sulphuretted Hydrogen Water.—Cooke recommends the use of an apparatus like those employed in the manufacture of soda water.—*Zeitschrift Anal. Chemie.*

No. 46, 1878.

A commission has been appointed for the revision of the *Pharmacopœia Germanica.*

Dr. Werner Siemens criticises recent popular newspaper essays on the conversion of mechanical power into electricity, and the re-conversion of the latter into mechanical power. He shows that, in common with others, he had pointed out the future importance of this principle for the production of light, the conveyance of motive power, and other technical purposes. But all this passed unnoticed until it was re-discovered by an American.

The electric light is finding extended applications. At Bremen a ship, bearing this light at its prow, has been able to sail down the river at full speed in the night. The Imperial dockyards at Kiel are now illuminated on Jablochkoff's principle.

At Dresden chocolate-powder has been found coloured with aniline-red, to conceal the inferior quality of the materials.

The dye manufacturers J. R. Geigy, of Basel, and P. Monnet and Co., of Geneva, have received gold medal at the late Paris Exhibition.

Poehl has detected coniin in a sample of aniseed, though microscopic examination had proved the absence of hemlock seeds. Considering that both plants belong to the same family of the Umbelliferæ, and bloom about the same time, he conjectures that the seed in question was derived from hybrids, and contained simultaneously the chemical principles of both the original plants.

Separation of Iron and Uranium.—E. Burker shows that the separation of these metals by means of ammonic carbonate gives inaccurate results, as a double carbonate of uranium nnd ammonia is liable to be formed. He selects as accurate the method described by Rose, who precipitates the mixed solution with ammonia, weighs the ignited precipitate, and then heats it in a current of hydrogen till no further loss of weight takes place, metallic iron and uranous oxide being formed. This residue is then treated with dilute hydrochloric acid, which dissolves the iron, leaving the uranous oxide untouched.—*Chem. Centralblatt*, 1878, p. 453.

S. Marcus, of Vienna, is said to have succeeded in dividing the electric light, and to have applied for patents in all states before Mr. Edison announced his discovery.

Reimann's Färber Zeitung,
No. 43, 1878.

The Färber-Academie (School of Dyeing), founded at Berlin by Dr. Reimann, does not seem to flourish as we might naturally expect, the balance this year being more unfavourable than the foregoing. The author considers that in England and in Austria more energetic steps are taken than in Germany for the scientific training of persons engaged in the tinctorial arts.

Dr. Reimann quotes from the *Deutsche Wollengewerbe* a protectionist ditty, levelled of course against the English trade, which he says "strikingly characterises our industrial misery.".

Les Mondes, Revue Hebdomadaire des Sciences.
No. 10, November 7, 1878.

The editor apologises for a mistake in his notice of M. Latour's work on gluttony, conveying "a grave accusation against the prelates and the curés." He intimates that an enemy has intentionally suppressed his correction of the obnoxious passage.

The "captive balloon," without its accessories, has been sold to "M. Goock," manager of the Princess's Theatre, London.

No. 11, November 14, 1878.

Ignition of Hydrogen by Powdered Zinc.—In works where zinc chloride is obtained on a large scale by dissolving metallic zinc in dilute hydrochloric acid, violent explosions occur which have not been explained. M. P. W. Hoffmann thinks that these explosions are due to finely divided zinc carried along to parts where the proportions of hydrogen and of atmospheric air form an explosive mixture. The brisk effervescence which ensues when a large quantity of zinc is thrown into dilute acid renders it possible for particles of zinc to be carried to a considerable distance.—(Explosions are also said to occur occasionally when large quantities of finely divided tin are treated with hydrochloric acid.—Ed. C. N.)

Use of Brine for the Preservation of Animal and Vegetable Matter.—M. Mercier, in the *Archives de Genève*, recommends a solution of common salt for the preservation of zoological and botanical specimens. It is cheaper than alcohol, does not evaporate, does not extract or alter the colours, and is not likely to be surreptitiously drunk. The brine is boiled to expel gas, and the specimens are immersed at about 80°, and closed up.

Microphone Constructed by M. Trouvé.

Apparatus for Demonstrating the Declination and Inclination of the Magnetic Needle.—These two papers require the accompanying illustrations.

Revue Universelle des Mines, de la Metallurgie, &c.,
Tome 4, No. 1, July and August, 1878.

On the Production of Cyanides and Chlorides in Blast Furnaces.—A. von Kerpely.—A saline mass was repeatedly formed at the Etelka iron-works (Hungary), which consisted principally of the cyanide and chloride of potassium.

Bulletin de la Societe Chimique de Paris,
Tome 30, Nos. 8 and 9, Nov. 5, 1878.

This issue contains no original matter, being made up of extracts from the *Berichte der Deutsch. Chem. Gesell.*, from *Liebig's Annalen*, the *Comptes Rendus*, and the Chemical News.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

NOVEMBER, 1878.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Slightly turbid	0·000	0·011	0·195	0·061	21·90	7·280	0·586	0·72	1·260	14·3	3·30
West Middlesex	Slightly turbid	0·000	0·010	0·150	0·057	21·00	7·840	0·684	0·72	1·430	13·2	4·60
Southwark and Vauxhall	Clear	0·000	0·007	0·135	0·073	19·90	7·530	0·540	0·79	1·000	14·8	4·20
Chelsea	Clear	0·000	0·009	0·165	0·007	19·00	7·750	0·612	0·72	0·840	14·3	2·80
Lambeth	Clear	0·000	0·010	0·150	0·069	22·00	7·560	0·468	0·72	1·600	14·3	3·70
Other Companies.												
Kent	Clear	0·000	0·001	0·450	0·003	29·40	11·230	0·936	1·29	2·800	18·2	5·10
New River	Clear	0·000	0·005	0·180	0·017	20·40	6·880	0·540	0·79	1·030	13·7	2·80
East London	Clear	0·000	0·007	0·105	0·034	21·50	7·280	0·684	1·00	0·840	13·7	4·20

The quantities of the several constituents are stated in grains per imperial gallon.

Note.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours.

C. Meymott Tidy, M.B.

MISCELLANEOUS.

The Royal Society.—On St. Andrew's Day the Anniversary Meeting of the Royal Society was held. The following Officers were elected for the ensuing year :—

President—William Spottiswoode, M.A., LL.D.

Treasurer—John Evans, F.G.S., V.P.S.A.

Secretaries—Prof. George Gabriel Stokes, M.A., D.C.L., LL.D.; Prof. Thomas Henry Huxley, LL.D.

Foreign Secretary—Prof. Alexander William Williamson, Ph.D.

Other Members of the Council—Frederick A. Abel, C.B., V.P.C.S.; William Bowman, F.R.C.S.; William Carruthers, F.L.S.; Major-General Henry Clerk, R.A.; William Crookes, V.P.C.S.; Sir William Robert Grove, M.A.; Augustus G. Vernon Harcourt, F.C.S.: Sir Joseph Dalton Hooker, C.B., K.C.S.I., D.C.L.; Vice-Admiral Sir Astley Cooper Key, K.C.B.; Lieut.-General Sir Henry Lefroy, C.B.; Lord Lindsay, P.R.A.S.; Sir John Lubbock, Bart., V.P.L.S.; Lord Rayleigh, M.A.; Charles William Siemens, D.C.L.; John Simon, C.B., D.C.L.: Prof. Allen Thomson, M.D., F.R.S.E.

In presenting the Medals, the President gave a brief *résumé* of the work in recognition of which the Medals were awarded. The Copley Medal was awarded to M. Boussingault, the Royal Medals to Mr. J. A. Broun and Dr. Günther, the Rumford Medal to M. Cornu, and the Davy Medal to MM. Louis Cailletet and Raoul Pictet.

The Royal Institution.—The following are the arrangements for the Lectures before Easter;—

Prof. Dewar, M.A., F.R.S.—Six Lectures adapted to a Juvenile Auditory, on a Soap Bubble; on Dec. 28 (Saturday), 31, 1878; Jan. 2, 4, 7, 9, 1879.

Prof. Edward A. Schäfer, F.R.S.—Twelve Lectures on Animal Development; on Tuesdays, Jan. 14 to April 1.

J. H. Gordon.—Four Lectures on Electric Induction; on Thursdays, Jan. 16 to Feb. 6.

Prof. Tyndall, D.C.L., F.R.S., &c.—Eight Lectures on Sound, including its Recent Applications and Methods of Reproduction; on Thursdays, Feb. 13 to April 3.

Prof. H. G. Seeley, F.L.S., F.G.S.—Three Lectures on Reptilian Life; on Saturdays, Jan. 18, 25, Feb. 1.

Reginald W. Macan (Ch. Ch. Oxford).—Four Lectures on Lessing; on Saturdays, Feb. 8 to March 1.

Walter H. Pollock, M.A.—Two Lectures on Colbert and Richelieu; on Saturdays, March 8, 15.

F. Seymour Haden.—Three Lectures on Etching; on Saturdays, March 22 to April 5.

The probable arrangements for the Friday Evening Meetings before Easter, 1879, to which Members and their Friends only are admitted, are as follows :—

Friday, Jan. 17.—Prof. Tyndall, LL.D., F.R.S., M.R.I., The Electric Light.

Friday, Jan. 24.—Prof. W. E. Ayrton, The Mirror of Japan and its Magic Quality.

Friday, Jan. 31.—H. Heathcote Statham, The Logic of Architectural Design.

Friday, Feb. 7.—Rev. H. R. Haweis, M.A., Bells.

Friday, Feb. 14.—Prof. G. Johnstone Stoney, F.R.S., The Story of the November Meteors.

Friday, Feb. 21.—Prof. Roscoe, F.R.S., A New Chemical Industry.

Friday, Feb. 28.—Sir William Thomson, LL.D., F.R.S., The Sorting Demon of Maxwell.

Friday, March 7.—Prof. Huxley, LL.D., F.R.S.

Friday, March 14.—E. B. Tylor, F.R.S., The History of Games.

Friday, March 21.—Prof. Abel, C.B., F.R.S., Recent Contributions to the History of Detonating Agents.

Friday, March 28.—Sir Henry C. Rawlinson, K.C.B., D.C.L., F.R.S., The Geography of the Oxus, and the Changes of its Course at Different Periods of History.

Friday, April 4.—Warren de la Rue, D.C.L., F.R.S., M.R.I.

NOTES AND QUERIES.

Grease, Varnish, &c.—Will any of your numerous readers kindly give me any information as to the best method of manufacturing locomotive, train, and water-wheel grease? Also black, red, and bright varnish. Could you give me any information as to the making of resin pitch. Any information will be gladly received.—R. J.

Examination of Fats, &c.—Can any reader kindly refer me to any work or papers on the qualitative and, so far as possible, the quantitative examination of mixtures of fats, oils, and resins? I am of course aware that complete separation is in many cases impossible. —F.C.S.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 9th.—Medical, 8.30.
—— Royal Geographical, 8.30.
—— London Institution, 5.
TUESDAY, 10th.—Civil Engineers, 8.
—— Photographic, 8.
—— Anthropological, 8.
WEDNESDAY, 11th.—Society of Arts, 8.
—— Microscopical, 8.
THURSDAY, 12th.—Royal, 8.30.
—— Royal Society Club, 6.30.
FRIDAY, 13th.—Astronomical 8.
—— Quekett, 8.
SATURDAY, 14th.—Physical, 3. "On a Condenser of Variable Capacity," by C. Boys. On a Differential Air Thermometer," by Dr. O. J. Lodge.

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An Examination in Practical Chemistry in connection with the Institute of Chemistry will be held during the last week of January next. Examiner, Dr. W. J. Russell, F.R.S. Candidates can obtain further information on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London, W.C.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 994.

ON THE ILLUMINATION OF LINES OF MOLECULAR PRESSURE, AND THE TRAJECTORY OF MOLECULES.*

By WILLIAM CROOKES, F.R.S., V.P.C.S.

Induction Spark through Rarefied Gases. Dark Space round the Negative Pole.

THE author has examined the dark space which appears round the negative pole of an ordinary vacuum tube when the spark from an induction coil is passed through it. He describes many experiments with different kinds of poles, a varying intensity of spark, and different gases, and arrives at the following propositions.

Illumination of Lines of Molecular Pressure.

a. Setting up an intense molecular vibration in a disk of metal by electrical means excites a molecular disturbance which affects the surface of the disk and the surrounding gas. With a dense gas, the disturbance extends a short distance only from the metal; but, as rarefaction continues, the layer of molecular disturbance increases in thickness. In air at a pressure of 0·078 millim. this molecular disturbance extends for at least 8 millims. from the surface of the disk, forming an oblate spheroid around it.

b. The diameter of this dark space varies with the exhaustion; with the kind of gas in which it is produced; with the temperature of the negative pole; and, in a slight degree, with the intensity of the spark. For equal degrees of exhaustion it is greatest in hydrogen and least in carbonic acid, as compared with air.

c. The shape and size of this dark space do not vary with the distance separating the poles; nor, only very slightly, with alteration of battery power; nor with intensity of spark. When the power is great the brilliancy of the unoccupied parts of the tube overpowers the dark space, rendering it difficult of observation; but, on careful scrutiny, it may still be seen unchanged in size; nor does it alter even when, with a very faint spark, it is scarcely visible. On still further reduction of the power it fades entirely away, but without change of form.

The author describes numerous experiments, devised to ascertain if this visible layer of molecular disturbance is identical with the invisible layer of molecular pressure or stress, the investigation of which has occupied him for some years.

The Electrical Radiometer.

One of these experiments is as follows:—An ordinary radiometer is made, with aluminium disks for vanes, each disk coated with a film of mica. The fly is supported by a hard steel cup instead of a glass cup, and the needle point on which it works is connected by means of a wire with a platinum terminal sealed into the glass. At the top of the radiometer bulb a second terminal is sealed in. The radiometer can therefore be connected with an induction coil, the movable fly being made the negative pole.

Passing over the phenomena observed at low exhaustions, the author finds that, when connected with the coil, a halo of a velvety violet light forms on the metallic side of the vanes, the mica side remaining dark throughout these experiments. As the pressure diminishes, a dark space is seen to separate the violet halo from the metal. At a pressure of half a millim. this dark space extends to the glass, and positive rotation commences.

On continuing the exhaustion, the dark space further widens out and appears to flatten itself against the glass, and the rotation becomes very rapid.

When aluminium cups are used for the vanes instead of disks backed with mica, similar appearances are seen. The velvety violet halo forms over each side of the cup. On increasing the exhaustion the dark space widens out, retaining almost exactly the shape of the cup. The bright margin of the dark space becomes concentrated at the concave side of the cup to a luminous focus, and widens out at the convex side. On further exhaustion, the dark space on the convex side touches the glass, when positive rotation commences, becoming very rapid as the dark space further increases in size, and ultimately flattening against the glass.

Convergence of Molecular Rays to a Focus.

The subject next investigated is the convergence of the lines of force to a focus, as observed with the aluminium cup. As this could not be accomplished during rapid rotation, an instrument was made, having the cup-shaped negative pole fixed, instead of movable. On exhaustion, the convergence of the lines of force to a focus at the concave side was well observed. When the dark space is very much larger than the cup, it forms an irregular ellipsoid drawn in towards the focal point. Inside the luminous boundary a focus of dark violet light can be seen converging, and, as the rays diverge on the other side of the focus, spreading beyond the margin of the dark space; the whole appearance being strikingly similar to the rays of the sun reflected from a concave mirror through a foggy atmosphere.

Green Phosphorescent Light of Molecular Impact.

At very high exhaustions the dark space becomes so large that it fills the tube. Careful scrutiny still shows the presence of the dark violet focus, and the part of the glass on which fall the rays diverging from this focus shows a sharply defined spot of greenish yellow light. On still further exhaustion, and especially if the cup is made positive, the whole bulb becomes beautifully illuminated with greenish yellow phosphorescent light.

This greenish yellow phosphorescence, characteristic of high exhaustions, is frequently spoken of in the paper. It must be remembered, however, that the particular colour is due to the special kind of soft German glass used. Other kinds of glass phosphoresce in a different colour. The phosphorescence takes place only under the influence of the negative pole. At an exhaustion of 4 M,* no light other than this is seen in the apparatus. At 0·9 M the phosphorescence is about at its maximum. When the exhaustion reaches 0·15 M the spark has a difficulty in passing, and the green light appears occasionally in flashes only. At 0·06 M the vacuum is almost non-conductive, and a spark can be forced through only by increasing the intensity of the coil, and well insulating the tube and wires leading to it. Beyond that exhaustion nothing has been observed.

Focus of Molecular Force.

In an apparatus specially constructed for observing the position of the focus, the author found that the focal point of the green phosphorescent light was at the centre of curvature, showing that the molecules by which it is produced are projected in a direction normal to the surface of the pole. Before reaching the best exhaustion for the green light, another focus of blue-violet light is observed; this varies in position, getting further from the pole as the exhaustion increases. In the apparatus described, at an exhaustion of 19·3 M, these two foci are seen simultaneously, the green being at the centre of curvature, while the blue focus is at nearly twice the distance.

Nature of the Green Phosphorescent Light.

The author adduces the following characteristics of the green phosphorescent light, as distinguishing it from the

* Abstract of a paper read before the Royal Society, Dec. 5, 1878.

* M signifies the millionths of an atmophere.

ordinary light observed in vacuum-tubes at lower exhaustions:—

a. The green focus cannot be seen in the space of the tube, but where the projected beam strikes the glass only.

b. The position of the positive pole in the tube makes scarcely any difference to the direction and intensity of the lines of force which produce the green light. The positive pole may be placed in the tube either at the extremity opposite the negative pole, or below it, or by its side.

c. The spectrum of the green light is a continuous one, most of the red and the higher blue rays being absent; while the spectrum of the light observed in the tube at lower exhaustions is characteristic of the residual gas. No difference can be detected by spectrum examination in the green light, whether the residual gas be nitrogen, hydrogen, or carbonic acid.

d. The green phosphorescence commences at a different exhaustion in different gases.

e. The viscosity of a gas is almost as persistent a characteristic of its individuality as its spectrum. The author refers to a preliminary note and a diagram* of the variation of viscosity of air, hydrogen, and other gases at exhaustions between 240 M and 0·1 M. From these and other unpublished results, the author finds that the viscosity of a gas undergoes very little diminution between atmospheric pressure and an exhaustion at which the green phosphorescence can be detected. When, however, the spectral and other characteristics of the gas begin to disappear, the viscosity also commences to decline, and at an exhaustion at which the green phosphorescence is most brilliant, the viscosity has rapidly sunk to an insignificant amount.

f. The rays exciting green phosphorescence will not turn a corner in the slightest degree, but radiate from the negative pole in straight lines, casting strong and sharply defined shadows from objects which happen to be in their path. On the other hand, the ordinary luminescence of vacuum tubes will travel hither and thither along any number of curves and angles.

Projection of Molecular Shadows.

The author next examines the phenomena of shadows cast by the green light. The best and sharpest shadows are cast by flat disks and not by narrow-pointed poles; no green light whatever is seen in the shadow itself, no matter how thin, or whatever may be the substance from which it is thrown.

From these and other experiments, fully described in the paper, he ventures to advance the theory that the induction spark actually illuminates the lines of molecular pressure caused by the electrical excitement of the negative pole. The thickness of the dark space is the measure of the mean length of the path between successive collisions of the molecules. The extra velocity with which the molecules rebound from the excited negative pole keep back the more slowly moving molecules which are advancing towards that pole. The conflict occurs at the boundary of the dark space, where the luminous margin bears witness to the energy of the collisions.

When the exhaustion is sufficiently high for the mean length of path between successive collisions to be greater than the distance between the fly and the glass, the swiftly moving rebounding molecules spend their force, in part or in whole, on the sides of the vessel, and the production of light is the consequence of this sudden arrest of velocity. The light actually proceeds from the glass, and is caused by fluorescence or phosphorescence on its surface. No light is produced by a mica or quartz screen, and the more fluorescent the material the better the luminosity. Here the consideration arises that the greenish yellow light is an effect of the direct impact of the molecules in the same electrical state on the surface of the glass. The shadows are not optical, but are molecular shadows, revealed only by an ordinary illuminating effect; this is proved by the sharpness of the shadow when projected from a wide pole.

Phosphorescence of Thin Films.

An experiment is next described in which a film of uranium glass, sufficiently thin to show colours of thin plates, is placed in front of a thick plate of the same glass; the whole being enclosed in a tube with terminals, and exhausted to a few millionths of an atmosphere. Of this the following observations are recorded:—

a. The uranium film, being next to the negative pole, casts a strong shadow on the plate.

b. On making contact with the coil, the thin film flashes out suddenly all over its surface with a yellowish phosphorescence, which, however, instantly disappears. The uncovered part of the plate does not become phosphorescent quite suddenly, but the phosphorescence is permanent as long as the coil is kept at work.

c. With an exceedingly faint spark the film remains more luminous than the plate, but on intensifying the spark the luminosity of the film sinks, and that of the uncovered part of the plate increases.

d. If a single intense spark be suddenly sent through the tube, the film becomes very luminous, while the plate remains dark.

These experiments are conclusive against the phosphorescence being an effect of the radiation of phosphorogenic ultra-violet light from a thin layer of arrested molecules at the surface of the glass, for were this the case the film could under no circumstances be superior to the plate.

The momentary phosphorescence and rapid fading of the film prove more than this. The molecular bombardment is too much for the thin film. It responds thereto at first, but immediately gets heated by the impacts, and then ceases to be luminous. The plate, however, being thick, bears the hammering without growing hot enough to lose its power of phosphorescing.

Mechanical Action of Projected Molecules.

When the coil was first turned on, the thin film was driven back at the moment of becoming phosphorescent, showing that an actual material blow had been given by the molecules. Experiments are next described in which this mechanical action is rendered more evident. A small rotating fly, capable of being moved about in any part of an exhausted bulb, is used as an indicator, and by appropriate means the molecular shadow of an aluminium plate is projected along the bulb. Whether entirely in or entirely out of the shadow the indicator scarcely moves, but when immersed so that one-half is exposed to molecular impact the fly rotates with extreme velocity.

Magnetic Deflection of Lines of Molecular Force.

With this apparatus another phenomenon was investigated. It is found that the stream of molecules, whose impact on the glass occasions evolution of light, is very sensitive to magnetic influence, and by bringing one pole of an electro-magnet—or even of a small permanent magnet—near, the shadow can be twisted to the right or to the left.

When the little indicator was placed entirely within the molecular shadow no movement was produced. As soon, however, as an adjacent electro-magnet was excited, the shadow was twisted half off the indicator, which immediately rotated with great speed.

The Trajectory of Molecules.

The amount of deflection of the stream of molecules forming a shadow is in proportion to the magnetic power employed.

The trajectory of the molecules forming the shadow is curved when under magnetic influence; the action of the mag net is to twist the trajectory of the molecules round in a direction at an angle to their free path, and to a

* *Proc. Royal Society*, Nov. 16, 1876, vol. xxv., p. 305.

greater extent as they are nearer the magnet: the direction of twist being that of the electric current passing round the electro-magnet.

Laws of Magnetic Deflection.

An apparatus was constructed so that the deflection of a spot of light was used instead of that of a shadow; a horseshoe magnet being placed underneath the negative pole to deflect the trajectory. The action of the north pole being to give the line of molecules a spiral twist one way, and that of the south pole being to twist it the other way, the two poles side by side compel the line to move in a straight line up or down, along a plane at right angles to the plane of the magnet and a line joining its poles.

The ray of molecules does not appear to obey Ampère's law, as it would were it a perfectly flexible conductor, joining the negative and the positive pole. The molecules are projected from the negative, but the position of the positive pole—whether in front, at the side, or even behind the negative pole—has no influence on their subsequent behaviour, either in producing phosphorescence, or mechanical effects, or in their magnetic deflection. The magnet gives their line of path a spiral twist, greater or less according to its power, but diminishing as the molecules get further off.

Numerous experiments were tried in this apparatus with different gases, and with the magnet in and out of position.

Working with exhausted air it was found that the spot of green phosphorescence on the screen is visible at an exhaustion of 102·6 M, when the mean free path of the molecules, measured by the thickness of the dark space round the negative pole, is only 12 millims. Hence it follows that a number of molecules sufficient to excite green phosphorescence on the screen are projected the whole distance from the pole to the screen, or 102 millims., without being stopped by collisions.

Alteration of Molecular Velocity.

If we suppose the magnet to be permanently in position, and thus to exert a uniform downward pull on the molecules, we perceive that their trajectory is much curved at low exhaustions, and gets flatter as the exhaustion increases. A flatter trajectory corresponds to a higher velocity. This may arise from one of two conditions; either the initial impulse given by the negative pole is stronger or the resisting medium is rarer. The latter is probably the true one. The molecules which produce the green phosphorescence must be looked upon as in a state differing from those arrested by frequent collisions. The latter impede the velocity of the free molecules and allow longer time for magnetism to act on them; for, although the deflecting force of magnetism might be expected to increase with the velocity of the molecules, Prof. Stokes has pointed out that it would have to increase as the square of the velocity, in order that the deflection should be as great at high as at low velocities.

Comparing the free molecules to cannon-balls, the magnetic pull to the earth's gravitation, and the electrical excitation of the negative pole to the explosion of the powder in the gun, the trajectory will be flat when no gravitation acts, and curved when under the influence of gravitation. It is also much curved when the ball passes through a dense resisting medium; it is less curved when the resisting medium gets rarer; and, as already shown, intensifying the induction spark, equivalent to increasing the charge of powder, gives greater initial velocity, and therefore flattens the trajectory. The parallelism is still closer if we compare the evolution of light seen when the shot strikes the target, with the phosphorescence on the glass screen from molecular impacts.

Focus of Heat of Molecular Impact.

The author finally describes an apparatus in which he shows that great heat is evolved when the concentrated focus of rays from a nearly hemispherical aluminium cup is deflected sideways, to the walls of the glass tube, by a magnet. By using a somewhat larger hemisphere, and allowing the negative focus to fall on a strip of platinum-foil, the heat rises to the melting-point of platinum.

An Ultra-gaseous State of Matter.

The paper concludes with some theoretical speculations on the state in which the matter exists in these highly-exhausted vessels. The modern idea of the gaseous state is based upon the supposition that a given space contains millions of millions of molecules in rapid movement in all directions, each having millions of encounters in a second. In such a case, the length of the mean free path of the molecules is exceedingly small as compared with the dimensions of the vessel, and the properties which constitute the ordinary gaseous state of matter, which depend upon constant collisions, are observed. But by great rarefaction the free path is made so long that the hits in a given time may be disregarded in comparison to the misses, in which case the average molecule is allowed to obey its own motions or laws without interference; and if the mean free path is comparable to the dimensions of the vessel, the properties which constitute gaseity are reduced to a minimum, and the matter becomes exalted to an ultra-gaseous state, in which the very decided but hitherto masked properties now under investigation come into play

Rays of Molecular Light.

In speaking of a ray of molecular light the author has been guided more by a desire for conciseness of expression than by a wish to advance a novel theory. But he believes that the comparison, under these special circumstances, is strictly correct, and that he is as well entitled to speak of a ray of molecular or emissive light when its presence is detected only by the light evolved when it falls on a suitable screen, as he is to speak of a sunbeam in a darkened room as a ray of vibratory or ordinary light when its presence is to be seen only by interposing an opaque body in its path. In each case the invisible line of force is spoken of as a ray of light, and if custom has sanctioned this as applied to the undulatory theory, it cannot be wrong to apply the expression to emissive light. The term emissive light must, however, be restricted to the rays between the negative pole and the luminous screen: the light by which the eye then sees the screen is, of course, undulatory.

The phenomena in these exhausted tubes reveal to physical science a new world—a world where matter exists in a fourth state, where the corpuscular theory of light holds good, and where light does not always move in a straight line; but where we can never enter, and in which we must be content to observe and experiment from the outside.

ON THE

METHOD OF EXTRACTING GOLD, SILVER, AND OTHER METALS FROM PYRITES.*

By W. A. DIXON, F.C.S., Cor. Mem. Nat. Hist. Soc. Glasgow.

SOME three years since, Mr. Wood, Under Secretary for Mines, suggested to me that the extraction of gold from complex minerals was a subject well worthy of investigation, and one which if brought to a successful issue would be of great value to New South Wales and Queensland. Both these Colonies yield minerals containing gold, and that often in considerable quantity, but so mixed up with sulphides of copper, lead, iron, and other metals, that none of the ordinary methods of treatment extract more than a very small proportion of it.

* Read before the Royal Society of N.S.W., August 1, 1877.

Acting on this suggestion, I obtained some pyrites from Mariner's Reef, Gympie, which in the rough yielded on analysis:—

Copper	6·2 per cent.
Lead	0·19 per cent.
Gold	3 ozs. 3 dwts. 2 grs. per ton.
Silver	32 ozs. 9 dwts. 3 grs. per ton.

Another larger portion from the same reef, after being ground and washed so as to remove as much as possible of the quartz, which was found to amount to about 60 per cent of the rough mineral, gave—

Copper	17·02	Copper pyrites	48·45
Lead	2·01	Iron „	35·95
Antimony ..	3·90	Galena	2·31
Gold and silver	0·22	Sulphide of antimony ..	5·44
Iron	31·41	Sulphide of arsenic ..	0·68
Sulphur	37·86	Gold and silver	0·22
Silica	7·16	Silica	7·16
Arsenic and loss	0·42		
	100·00		100·21

Gold .. 12 ozs. 10 dwts. 0 grs.
Silver .. 62 ozs. 9 dwts. 16 grs. } per ton.

I had also a small lot of copper pyrites from this Colony containing 24 per cent of copper, and gold equal to 78 ozs. 8 dwts., and silver 4 ozs. 2 dwts. 10 grs. per ton; arsenical pyrites containing when thoroughly roasted 11 ozs. 18 dwts. 0 grs. per ton; iron pyrites containing when roasted 5 ozs. 6 dwts. 3 grs. gold per ton.

As much attention has been given by others more conversant than myself with mechanical manipulation to the extraction of gold and silver, by grinding with mercury in variously designed apparatus, with comparatively small success so far as these complex ores are concerned, I have confined my attention principally to those chemical relations of gold which would enable me to obtain it in solution. I may note, however, that in Germany ores containing more than 1 per cent of copper, or 7 per cent of lead, have not been found suitable for amalgamation; and that an increase of density of the accompanying gangue from the presence of heavy spar, &c., or of tenacity from the presence of clay, seriously reduce the yield of precious metals, consisting in their case principally of silver; and that nearly all the gold is lost in the tailings, with about 15 ozs. of mercury per ton of ore treated.

The loss of silver by amalgamation, working with ores considered suitable for that process, has been found to vary in Germany from 5 to 10 per cent of the contained quantity.*

With the Comstock silver ores in America, the loss is 12 per cent by barrel amalgamation, whilst with the same ores by pan amalgamation the yield never exceeded 80 per cent, seldom 75 per cent, with a general average of 66 per cent.†

At the Port Phillip Works at Clunes, Mr. Latta reports that the average loss of gold by amalgamation in a period of seven years was 6 dwts. 10 grs. per ton, the highest loss being 7 dwts. 15 grs., the lowest 4 dwts. 8 grs., the pyrites being free, or nearly so, from copper and lead.‡

In treatment by fusion it is found at Kongsbeck, in Norway, that after repeated fusion slags carry away 1 oz. 2 dwts. of auriferous silver per ton; and in Lower Hungary, by a similar process, the loss is in the slags 1 oz. 12 dwts. per ton, besides a loss of 3½ per cent of the total silver in the smoke.

Rivot says:—"The yield of gold and silver from pyritical ores does not exceed 65 per cent of the assay, which is itself open to losses. According to many synthetical experiments, the loss is greater in assays of richer than of poor ores, amounting always to more than 30 per cent, and with fahlore and ores containing arsenical pyrites to more than 50 per cent. The loss incurred when working on a large scale is less than in laboratory assays. The difference between the yield on the large scale and the percentage by assay may exceed 30 per cent, even when the metallurgic method is quite perfect; but as the American methods are far from perfect, the difference is still greater."*

Many of the trials made during this investigation yielded negative results, and in others the yield of the precious metals was so small as to be of no practical value, and I shall therefore only give an outline of the methods adopted, with a few results selected from numerous experiments.

The quantity of material operated on in all cases was 3667 grains, from which quantity one-tenth grain represents 1 oz. per ton.

The first process which suggested itself for the extraction of gold was to take advantage of the solubility of sulphide of gold in solutions of alkaline sulphide, for if this could be effected it would render the roasting of the ores unnecessary.

In 1859, Henderson included in his patent for the extraction of copper, a process for extracting gold as sulphide. His directions are that the pyrites be fused to obtain a matt which is to be fused with two parts of salt cake (crude sulphate of sodium), and the matt run into pigs. These placed in water crumble to pieces; and the gold is obtained in solution, whence it may be recovered by precipitation with an acid.

In 1868, a process was patented in America for the extraction of gold by "sulphur and its salts," but of this I have no details.

The first experiments were made by treating portions of each ore with solution of sulphide of sodium containing a slight excess of sulphur. The experiments were varied in concentration of solution, in time of digestion from one to seven days, and in temperature, some being conducted at ordinary temperatures, others at 212° F. Twenty experiments were made altogether, and in no case was a trace of gold obtained on neutralising with acid, filtering off the precipitated sulphur, and igniting. From arsenical pyrites much arsenic was obtained in solution.

Henderson's process was tried with Mariner's Reef ore, proceeding exactly according to his directions, but although the regulus disintegrated in water as described by him, I could not, in two trials, obtain any gold in solution. This process was modified, with equally unsatisfactory results, by fusing with sulphide of sodium, by fusion with sulphate of sodium and charcoal, and by heating finely powdered ore to a dull red with sulphite of sodium, without fusion.

The extraction of gold from its ores as chloride was proposed by Price, who, in January, 1857, patented a process in America for the extraction of gold from its ores by fusing them with sulphide of iron, and treating the regulus with aqueous chlorine or an acidified hypochlorite. This introduced a source of difficulty, as the chlorine would have to convert the sulphide into ferric sulphate before any gold could be obtained in solution.

Ziervogel proposed treating roasted pyrites with chlorine, and his process was used at Chemnitz.

This process was afterwards patented in the United States by G. F. Deetken, in 1863, and has been used with tolerably satisfactory results in California in two establishments. The process is there carried out as follows:—The concentrated pyrites are subjected to a thorough calcination, and when sulphurous anhydride ceases to be evolved, the residue is withdrawn from the furnace and cooled. It is then sprinkled with water, and turned over several times until uniformly damped, the exact condition in this respect being a matter of considerable importance. It is then placed in a large wooden vat, having a false

* Watts's "Dictionary of Chemistry," article Silver.
† S. A. Phillips's "Mining and Metallurgy of Gold and Silv ."
‡ *Trans. R. Soc., N.S.W.*

* Rivot, *Ann. Min.* [6] vii 1. Watts's "Dict. Chem.," Second Supplement, p. 572.

bottom, and chlorine gas from a generator is admitted below until it is seen floating above the material. The tank is then closed, the current of gas stopped, and the whole left at rest for ten or twelve hours, when the cover is removed and water is run on. This dissolves the chloride of gold formed, and the solution is run into earthenware or glass vessels, where the gold is precipitated as a bronze-black powder by the addition of a solution of ferrous powder.

As it had been found that gold alloyed with much silver was not readily attacked by chlorine from the chloride of silver formed encrusting the granules, Paterno and afterwards Rösner proposed the use of chlorine dissolved in a concentrated solution of salt.

The disadvantage of the chlorine method of extraction is, that with ores containing copper the whole of that metal has to be removed before the chlorine becomes available, and also all the sulphur which otherwise becomes first oxidised to sulphuric acid.

With a view to removing the copper, I carefully roasted a quantity of ore in a muffle, at a dull-red heat, with constant stirring for seven hours, and extracted the residue with water and sufficient sulphuric acid to convert all oxide of copper into sulphate. The dried residue was found to contain 1·5 per cent of sulphur, and I therefore re-calcined the whole for seven hours longer, and extracted the copper as before, when the sulphur was found to be reduced to 0·46 per cent. A similar result was obtained in successive trials, and as this amount of sulphur would require as much chlorine, as upwards of 3300 ozs. of gold per ton, a more perfect method of getting rid of it was evidently required.

Another portion of ore was therefore partially calcined, cooled, and damped with brine, and the whole again calcined until fumes were no longer evolved.

The residue extracted with water and acid as before was found to contain 0·12 per cent of sulphur, and traces only of copper.

On assaying a portion of the residue, it was found to contain—

Gold	.. ..	3 ozs. 14 dwts. 8 grs. per ton.
Silver	.. ..	39 ozs. 18 dwts. 14 grs. ,,

A portion was ground up with mercury, and sufficient water to make it of the consistence of thick cream, in which the mercury was well broken up for an hour, and afterwards carefully washed, the tailings being gone over as often as any mercury was found. This yielded—

Gold ..1 oz. 0 dwts. 5 grs., leaving 2 ozs. 14 dwts. 3 gr.
Silver..6 ozs. 16 dwts. 10 grs., ,, 33 ozs. 2 dwts. 4 gr.

Another portion, shaken up with a solution of salt and pieces of iron to decompose the chloride of silver, and the residue ground up as before, yielded—

Gold .. 1 oz. 1 dwt. 0 gr., leaving 2 ozs. 15 dwts. 8 grs.
Silver..34 ozs. 3 dwts. 5 grs. ,, 5 ozs. 15 dwts. 9 grs.

These results showing that even after the most complete removal of sulphur, or at all events what would be considered complete on the large scale, the greater part of the gold present was untouched by the mercury, I proceeded to examine the effect of chlorine, of which I give the following as typical results:—

A portion treated with chlorine gas exactly as above described yielded gold, 16 dwts. 10 grs., leaving 2 ozs. 17 dwts. 22 grs.

A portion treated with ½ oz. of calcium hypochlorite and sulphuric acid, with sufficient water shaken up in a bottle for twenty-four hours (it then smelt strongly of chlorine), was filtered through an asbestos filter, the residue well washed, and the gold precipitated—yielded 1 oz., leaving 2 ozs. 14 dwts 8 grs. The dried residue was found to be free from sulphur.

A portion mixed with brine and the same quantity of reagents as above, and otherwise similarly treated, yielded gold 1 oz. 2 dwts. 5 grs., leaving 2 ozs. 12 dwts. 3 grs. The residue digested with water containing ½ oz. hyposulphite of sodium, the solution acidified and treated with sulphureted hydrogen, gave—

	Ozs.	Dwts.	Grs.
Gold	22	14	19
Silver	0	3	0

Roasted arsenical pyrites, treated with hypochlorite of calcium and sulphuric acid as above, gave —gold, 11 ozs. 15 dwts. 5 grs., leaving 2 dwts. 19 grs. Roasted iron pyrites, similarly treated, gave—gold, 5 ozs. 1 dwt., leaving 5 dwts. 3 grs.

The two last results show that with these simple pyrites the treatment with hypochlorite and acid gives very fair results, and this being a process involving no troublesome apparatus it might be sometimes applied with advantage.

(To be continued)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 5, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors, reading of minutes, &c., the following certificates were read for the first time:—F. R. Japp, J. J. Broadbent, W. Stevenson, E. A. Letts.

During the meeting the following gentlemen were duly elected Fellows of the Society:—E. Waller, Shigetake Siguira, H. F. Cheshire, J. Treharne, H. J. H. Fenton, H. Green, J. Collins, W. J. Noble, D. McAlpine, A. E. Drinkwater, L. Green, Kingo Takemura, G. W. Hatter, P. H. Walsh, J. J. Watts, H. Eccles, E. W. Napper, and A. C. Arnold.

The PRESIDENT then called on C. MEYMOTT TIDY, M.B., to read his paper on "*The Processes for determining the Organic Purity of Potable Waters.*" The determination of the organic matter in potable waters, both as regards its quantity and its quality, has been a subject of late years productive of much discussion, of much difference of opinion, and of much warmth of feeling. The author wished to lead and urge the discussion in a strictly scientific groove, unfettered and unimpelled by that warmth of feeling which has in this, as in many other questions, more often retarded than helped the attainment of that scientific accuracy to which we hope and desire that all our work and all our discussions should tend. The author trusts that nothing he may say will be regarded in any other light than a desire to discuss fairly the position of water analysis and the value to be attached to the various processes employed by water analysts. The processes for estimating the organic matter in water, naturally, divide themselves under two great heads:—(1.) Where the organic matter is estimated from a water residue. (2.) Where it is estimated in the original water, *i.e.*, from the water itself, and not from the residue after evaporation. It is here to be remarked that if it be possible, by any process or processes, to estimate the organic matter in the original water, such processes must have manifest advantages over those where the quantity of organic matter is deduced from a residue. The author then proceeds to discuss the processes which come under the first head, *The Ignition Process*; the first in respect of date, the last in respect of value. This process, to be of value, presupposes three things:—First, that no organic matter is lost and none gained during the evaporation of the water: in this point the process fails, because there may be both a loss of the actual organic matter present in the water, during evaporation,—such loss being

either physical, particles being carried off mechanically with the steam; or chemical, from decomposition,—and a gain resulting from the introduction of extraneous organic matter, in the shape of impurities floating in the laboratory atmosphere. Secondly, that all the organic matter is burnt off by the ignition of the residue; and thirdly, that nothing but organic matter is lost by ignition. With regard to both these points the ignition process also fails. The author gives details of some experiments which he made some years ago, in which he made analyses of four waters where the loss on incineration was very great, although they were as nearly as possible free from organic impurity. The author notes that the process is not quite abandoned, else there would be no need to refer to it; some analyses having been, not long ago, put in evidence where the loss on incineration was entirely relied on as the indication of organic purity or impurity. He finally refers to some cases where he thinks the loss on ignition may be of value,—as, for example, in cases of sewage,—and also the value to be attached to the smell evolved during the burning. The author then considers the *Combustion Process* of Drs. Frankland and Armstrong. The objections to this process are twofold: first, general; and secondly, special. The general objection is its impracticability, arising from the manipulative skill required, and the length of time consumed in conducting the process. These two latter objections may seem to have some weight at first sight, but very little on further consideration. It is admitted that a certain amount of manipulative skill is required; but the possession by practice of this manipulative skill constitutes a man an analytical chemist, and the sooner so delicate and difficult a work as water analysis is taken out of the hands of those who imagine themselves professional chemists after a few lessons in a laboratory, the better for Chemistry and Sanitary Science. As regards the time required, the author considers that rapidity ought not to enter into the calculation if accuracy or delicacy be thereby imperilled. This objection of impracticability is therefore worthless. The question of evaporation is then reviewed, including the ingenious devices of Prof. Bischof and Dr. Mills. Until we have definite evidence, says the author, that no organic matter is oxidised, and also that no organic matter is volatilised or destroyed by the heat required in evaporation, it follows that evaporation must always constitute a possible source of error in any process where the determination is made on the residue. Indeed we cannot resist the conclusion being forced upon us that, after all our trouble, we may be simply estimating the harmless organic matter, that which was poisonous and disease-producing having been carefully got rid of by our previous work. The next difficulty—the addition of the solution of sulphurous acid—is an important one. From a careful series of observations the author concludes that if the nitrogen present as nitrates does not exceed 1 part in 100,000, or 3·15 grms. of nitric acid per gallon, the reduction of the nitrates is complete on boiling with 10 or 20 c.c. of the sulphurous acid solution. If, however, the quantity present amounts to 1·5 per 100,000, some difficulty is experiencced in effecting complete reduction, even when 60 c.c. of sulphurous acid solution are used. The next step is the combustion of the residue. The author accepts without hesitation the determinations of organic carbon, and is quite satisfied as to the accuracy of the method, but at present does not attach the same value to the determinations of the organic nitrogen, and therefore he doubts how far we are justified in drawing conclusions as to the source of the organic matter, *i.e.*, whether it is vegetable or animal, from the proportion which exists between the organic carbon and nitrogen. However, the process has so much improved on acquaintanse that the author believes it to be of great value.

The processes where the organic matter is estimated from the water before evaporation are two, the Ammonia Process and the Oxygen Process. The *Ammonia Process* consists of the comparative determination of the nitrogenous organic matter by the quantity of ammoni ("albuminoid ammonia") yielded by the destruction of the organic matter. This destruction is effected by boiling the water in the presence of potas-ic permanganate and a large excess of caustic potash. Waters are divided by the authors of this process into three classes. Waters of extraordinary organic purity, yielding 0·000 to 0·05 part per million of albuminoid ammonia; safe waters, yielding 0·05 to to 0·10; and dirty waters, yielding more than 0·10. The objections made to the process by Dr. Frankland are, that the conversion of the nitrogen of the organic matter into ammonia is seldom or never complete, and that the proportion of nitrogen converted into ammonia in a series of nitrogenised bodies varies widely. There is a certain force in these objections. If the organic matter of all water was alike it would be of no importance whether the whole or a definite part of the nitrogen was converted; but, inasmuch as in all probability the organic matter of one water is not the organic matter of other waters, the circumstance that bodies yield their nitrogen as albuminoid ammonia in vastly different proportions constitutes an objection of some importance. Nevertheless, this objection can be overrated. If it can be shown that the ammonia process indicates clearly that the yield of albuminoid ammonia keeps pace with the purity or impurity of waters, and that it is sufficiently delicate to indicate the finer grades of purity, the fact that piperin yields all its nitrogen whilst thein yields one-fourth is of little significance in water analysis, whatever interest such facts possess for the scientific chemist. It must be remembered that Mr. Wanklyn has repeatedly and distinctly condemned the course taken by certain chemists in regarding his process as a method for the quantitative determination of nitrogen, and asserts that his process only answers the question, Is this water wholesome or is it not? Whilst it leaves untouched the question, How much organic nitrogen does this water contain? The author proceeds to notice some practical difficulties in the details of the process. It is practically impossible to prepare the alkaline solution of potassic permanganate absolutely free from ammonia, and it is always necessary to estimate the quantity of ammonia in the permanganate solution and deduct this from the total amount obtained in the actual experiment. It is a matter of extreme difficulty to effect the complete (*i.e.*, as complete as the alkaline permanganate solution is capable of effecting) decomposition of the organic matter by boiling the water with the permanganate solution, thus:—You distil a water with permanganate until ammonia ceases to be evolved, and then leave the apparatus carefully protected from contamination for a few hours; on re-distilling, a second yield of ammonia, often equal or even larger than the first, is obtained, and so again, and again, and again, fresh quantities of abuminoid ammonia may be obtained until every drop of water in the retort has been distilled over. This is a serious difficulty, and has in one case at least led one analyst to report a water to be of "extraordinary organic purity," whilst a second classes the same water as a "dirty water" and entirely unfit to drink. Sometimes, too, ammonia seems to disappear. Thus, the permanganate solution is known to yield a certain quantity of ammonia on distillation; it is added to a water and the two distilled, when the distillate from the water, plus the permanganate, contains less ammonia than the distillate from the permanganate alone. As regards Nesslerising, the author states that a serious error may creep in from the fact that eyes are very far from being equally sensitive in observing and in classifying tints. Thus, out of a large number of average men observed, 60 per cent failed to arrange a series of Nessler test solutions in the proper order of their tints. The presence of free ammonia within certain limits the author regards as of little importance, and entirely disagrees with Mr. Wanklyn when he regards the presence of more than 0·08 part of ammonia per million as evidence that that ammonia proceeds from the fermentation of urea. As a general conclusion from a wide

experience, the author thinks that the ammonia process gives fairly concordant results when uniformly conducted, *i.e.*, given solutions made by the same person, the same hands to manipulate, the same eyes to judge of the tint depths; but this is almost a fatal objection to its general employment, for if the author's statements be true, in the ammonia process every man must be a law unto himself, whilst one man's law is no one else's law. Hence, comparisons are rendered impossible. As a rule the albuminoid ammonia process enables you to say whether a water be of excellent quality or of an exceptionally bad quality, but in those more delicate and difficult cases, where a water is not what may be termed excellent, but nevertheless is not "dirty," in the opinion of the author, the ammonia process absolutely and entirely fails.

The next process considered by Prof. Tidy is the *Oxygen Process*. This process, when properly carried out, is much relied on by the author. He deprecates most strongly the ordinary method of using it. The proper plan of using the permanganate is the following:—Into two twenty-ounce flasks, cleaned by rinsing with sulphuric acid and then thorough washing under the tap, place 500 septems (1 septem = 7 grains = 1-1000th of a gallon) of the water; add to each 20 septems of dilute (1 in 3) sulphuric acid, and 20 septems of the permanganate solution (2 grains in 1000 septems). Note the exact time at which the permanate solution was added; at the same time two similar quantities of distilled water are to be treated in precisely the same manner. At the end of one hour and of three hours the oxygen used up by the water is to be determined. To the flasks, after standing the appointed time, add a sufficiency of potassic iodide (1 in 10), and then a standard solution of sodic hyposulphite (5·4 grains in 1000 septems) until the whole of the free iodine is removed, judging of the exact spot by the addition towards the end of the experiment of a few drops of starch solution. By deducting the quantity of oxygen equivalent to the hypo-solution used from that in the quantity of permanganate originally added, we obtain the quantity of oxygen used by the watet. The blank experiments with distilled water give the value of the hypo-solution. It is obvious the samples of water must have a pink tint at the end of the one hour or the three hours, otherwise fresh experiments must be made with larger doses of permanganate. The author then proceeds to consider the interference of various substances with the process. He concludes that the only important errors which can arise would be due to the presence of ferrous salts, sulphuretted hydrogen, and nitrites. The presence of the first two substances would sure to be discovered in the analysis, and by taste or smell; the nitrites act immediately on the permanganate solution, and any decolourisation taking place during the first five minutes must be due to nitrites and allowed for. Besides, even if a careless manipulator were to miss the iron, the sulphuretted hydrogen, and the nitrites, and estimate the whole as oxidisable organic matter, he would simply condemn a good water, but could never by using the oxygen process pass a bad water as harmless. It is admitted that permanganate fails to oxidise some substances, such as urea, but nevertheless the quantity of oxygen used affords evidence of the relative quantity of matter in the water which is likely to be injurious, and this is what we want in water analysis, as it enables us to speak with confidence as to the use or rejection of a water for drinking purposes. The quantity of oxygen used during the first, as compared with that used in the first three hours, gives valuable information as to the relative quantities of putrescent easily oxidisable matter and of non-putrescent and less easily oxidisable matters. The author also recommends as a valuable accessory the tint of the water as seen viewed through a 2-feet tube, 2 inches in diameter, daylight reflected from a white card being used. This tube is of special value in determining whether a water is peaty or not. In some cases the tint gives a clue to the quantity of organic matter present. The author, in conclusion, quotes Angus Smith's words as expressing his own views:—"Nothing ever pretends to do in water analysis what the permanganate test does. Those who neglect it leave out the putrid matter or drive it off in boiling." A comparison drawn from a large body of results was then made between the ammonia process and the other two processes, sometimes described as "processes of the past, possessing merely historic interest." The author has collected and plotted out in curves the results obtained by Dr. Frankland, using the combustion process; those obtained by Dr. Letheby and himself, using the oxygen process; and those obtained with the ammonia process, with the waters of the eight London companies since 1870. He finds that the curves of the oxygen and combustion processes are strikingly concordant, whilst that of the ammonia process agrees with neither. The author has also divided these results into classes, making as far as possible classes (with the three methods of estimating the organic matter), which should be comparable with each other. Thus, Class I. contains waters of great organic purity, which require less than 0·05 part of oxygen per 100,000 to oxidise their organic matter, or which give less than 0·1 part per 100,000 of organic carbon and nitrogen, or which yield less than 0·05 part per million of albuminoid ammonia. Compared in this way, out of 1686 experiments the oxygen and combustion processes tell the same tale in 1418 cases, and of the rest a large proportion have differences depending on the third decimal place. The results by the ammonia process correspond, save in a very general way, neither with those of the oxygen process nor with those obtained by the combustion process. The author has analysed, moreover, 200 miscellaneous waters, using the three processes in each case. Of these 94 were placed in the first class by the oxygen, and 92 by the combustion process, whilst only 42 were placed in the first class by the ammonia process. It must be understood that the author deprecates most strongly the judging of a water by one constituent without reference to its complete analysis and natural history, and has only instituted these classes for the sake of comparing results. The paper comes to an end with fifteen conclusions, the substance of which has already been given in the above report as to the relative value of the three processes. They may be briefly summed up as follows:—*The Ammonia Process* furnishes results which are marked by singular inconstancy, and are not delicate enough to allow the recognition and classification of the finer grades of purity or impurity. The errors incidental to the process form an array of difficulties which become infinitely serious, seeing that the range (from 0·05 to 0·1 part per million) between pure and dirty waters is comparatively so small. *The Combustion Process* has all the evils of evaporation to encounter, but the organic carbon estimation is trustworthy; the organic nitrogen determination, however, scarcely yields absolutely trustworthy evidence on which to found an opinion as to the probable source of the organic matter. *The Oxygen Process* avoids the errors incidental to evaporation; its results are constant and extremely delicate; it draws a sharp line between putrescent or probably pernicious and the non-putrescent or probably harmless organic matter. By it a bad water would never be passed as good. As far as the three processes are concerned the oxygen and combustion processes give closely concordant results, whilst those yielded by the ammonia process are often at direct variance with both.

Prof. TIDY occupied nearly two hours in giving an account of the above paper (which is over 100 pages) to a very full meeting of the Society. At its conclusion, after various suggestions had been made, it was moved by Mr. RILEY, seconded by Mr. NEISON, and carried unanimously, that the discussion should be adjourned until after the paper had been printed, when a Special Meeting would be called for the purpose. It was understood that, if possible, the paper should be printed in the January number of the Society's Journal.

The Society then adjourned to December 19th, when

the following papers will be read:—"Researches on the Action of the Copper-Zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe; "On the Formula of Glyoxylic Acid," by Dr. Debus; "On the Action of Isobutyric Anhydride on the Aromatic Aldehyds," by Mr. Perkin; "On the Production of Oxides of Nitrogen by the Electric Arc in Air," by J. Wills; "On Baric Periodate," by S. Siguira and C. F. Cross; "The Action of Alkaline Hypobromite on Oxamides, Cyanides, Ferrocyanides, and Cyanates," by W. Foster; "On a new Hydrocarbon obtained by the Action of Sodium Hydrochloride," by Dr. Letts; "On Erbium and Yttrium," by Dr. Humpidge and Mr. Burney.

NOTICES OF BOOKS.

The Art of Scientific Discovery, or the General Conditions and Methods of Research in Physics and Chemistry. By G. Gore, LL.D., F.R.S. London: Longmans and Co.

We have here a book which may perhaps be regarded as too ambitious in its objects, professing to be a newer and more practical *Novum Organon*. The author, however, attempts nothing essentially impossible. Unlike Bacon, he has "no wish even to suggest the idea of reducing all intellects to a level, nor to make success in research a matter merely of time and labour, nor to pretend that important discoveries can be completely made by rule alone." He pre-supposes, as necessary, "a certain amount of scientific knowledge, a disciplined mind, and manipulative skill." He fully recognises the truth that great aptitude for scientific discovery must, like any other peculiar ability, be "born in the man." Yet at the same time he contends that in this pursuit, as in all others, there are conditions of success and causes of failure, an exposition and analysis of which cannot fail to be of value to the student. To take a parallel instance, no one expects that such commanders as Napoleon, Wellington, or Moltke can be produced to order by any amount of training, yet at the same time works on the military art are considered indispensable for the young officer. In the fine arts, inborn genius is the primary condition without which all extraneous aids are idle. Yet without such aids genius is liable to go astray, to exert itself to little purpose, or to be lost altogether. It is important to know that Faraday, than whom no higher authority could be named, appears to have pronounced the framing of an art of scientific discovery by no means impossible.

Dr. Gore examines in succession the general basis of scientific research, its general conditions, the requisite personal preparations, the manner of actual working in research, and finally the special methods of discovery. Throughout the work, but especially in its latter portions, he illustrates and enforces his views by examples drawn from the history of scientific research. This feature renders the volume less "dry" to the general reader. Indeed, whoever peruses it carefully will acquire no contemptible knowledge of the career of discovery, of the difficulties it has had to encounter, and of the achievements of the leading men of science. On this account we can recommend it to the notice of all educated and thoughtful men, even though they may not have the least intention of devoting themselves to scientific research. We agree with him thoroughly in his evident estimate of the importance of research as being, intellectually considered, the highest of all human pursuits. We can fully endorse his statement of the external difficulties and hindrances with which it is beset, especially in England, and can rather wonder that so much has been done than feel any astonishment at our being outstripped by neighbouring countries in the quantity of scientific work. But we are less sanguine than he is as to any endowment of research or any such reform in our universities as the case demands. He complains that at our old universities students are absorbed in acquiring and contemplating what is already known, instead of pressing onward to discover new truths. He goes on:—"In Germany, where the teachers themselves possess the genius of origination, and in those institutions in this country where a similar condition exists, the students are encouraged in original work by their teachers, and thus acquire the art of making discoveries." Alas, where is the institution in which the highest honours, or indeed any honours at all, can be earned by discoveries only? Men still "read"—not work—for the degrees of B.Sc. and D.Sc. of London University, just as they "read" for degrees at Oxford and Cambridge. Nor do we see much hope that newer seats of learning will either be disposed to grant honours more rationally, or if willing, will receive legislative sanction. The two great political parties can be described as equally hostile. The Conservatives prefer scholarship to research, and are more curious about "longs and shorts" than about atoms and molecules. The Liberals, on their part, bow down to the Chinese idol known as competitive examination, and would not willingly assent to any measure by which his joss-house might be endangered.

Dr. Gore fully recognises that for success in discovery "a large amount of quiet leisure is almost indispensable." He admits that the men who, by writing manuals and other compilations, giving lectures, &c., contrive to make the most noise in the scientific world, are by no means the most fruitful in discoveries. We may instance the case of Dr. Lardner, who, we doubt not, was at one time regarded as a more eminent man than either Faraday or Dalton, yet who is now regarded as merely a clever exponent of other men's researches.

Concerning the influence of age upon the ability to make discoveries, the author holds views seemingly different from those of Dr. Beard. He holds that the power of research usually continues as long as the senses and intellect remain unimpaired. Yet on the same page, in speaking of Galileo, he adds, "the latter part of the time being, as is usual, most devoted to reflection, writing, systematising his knowledge, and getting it published." In natural connection with this subject, we are led to some remarks on the influence of scientific research upon health. "Investigators," we read, "are stimulated by the health and pleasure derivable from physical and mental activity." Yet elsewhere he quotes from W. C. McIntosh (*Psychological Journal*) the utterance that "deep studies and scientific pursuits are not the most natural objects of man, but opposed to his health and well-being." Our own observations, like those of Dr. Beard, support the former view, that brain-work is conducive to health and long life.

The following remark seems paradoxical: "Notwithstanding the vast amount of knowledge which remains to be discovered, it is extremely difficult to find a scientific truth which is both new and important." Yet it is no less true. Numbers of facts, depending for their detection most exclusively upon mere patience and manipulative dexterity, remain unknown, *e.g.*, boiling-points, melting-points, solubilities, quantities of heat evolved or absorbed during chemical or aggregational changes. Yet work of this kind, though highly useful, is "miserably unremunerative." Not only does it fall dead upon the outside public, but even in scientific circles the mere determiner of constants passes nearly unnoticed.

The author attaches great, though by no means exaggerated, importance to the study of residual phenomena and the examination of residual substances. He very judiciously advises the student to examine apparent exceptions to some law as a process not unlikely to lead to the discovery of a higher law. This advice requires a sound moral basis of character. The man not possessing a thorough love for truth turns away from exceptions, or seeks to shut his eyes to their very existence. Another

useful recommendation is to examine neglected truths, hypotheses, and substances. If, as is too often the case, we work upon something which is creating a sensation, the probability of our being anticipated is vastly greater than if we had taken up some unfashionable subject. There are many other points in this work to which we should have pleasure in drawing attention did space permit. Its chief defect seems to us a tendency to repetition, and an occasional introduction of what is commonplace, or of something which, however interesting, is beside the question. Thus an account of the persecutions undergone by discoverers would form an appropriate subject in a history of discovery. In a treatise on the art of discovery it is scarcely relevant. Advanced students, not merely of physics and chemistry, but of the organic sciences also, will derive many useful lessons from this book, and to their notice we especially recommend it.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 21, November 18, 1878.

New System of Electric Lights.—R. Werdermann'—This system, based on the effects of the incandescence of charcoal heated to white redness, is so arranged that when the electric generator is properly combined a great number of jets of light may be simultaneously kindled by the simple derivation of the current. It consists essentially of a loose piece of charcoal, movable in the interior of a metallic tube, which serves as a guide and as a communicator of the current. When the current was distributed between two lamps the light was equal to that of 360 standard candles. The light was white, free from the blue and red rays so frequently seen in the voltaic arc, and perfectly steady. If distributed among ten lamps the light of each equalled that of 40 candles.

Artificial Reproduction of Felspars and of a Complex Volcanic Rock (Pyroxenic Labradorite) by means of Igneous Fusion and Prolonged Exposure to a Temperature Bordering upon Fusion.—F. Fouqué and M. Lévy.—The nature of this paper will appear sufficiently from its title.

New Telephone.—C. Ader.—The author gives to his invention the name of electrophone. It consists of a sort of drum, fitted on one side only with a diaphragm of parchment paper 15 centimetres in diameter, to the centre of which are fixed circularly six small plates of tinned iron, 1 centimetre in length by 2 millimetres in breadth, acted on by six microscopic horse-shoe magnets, whose magnetic nucleus is not more than 1 m.m. in diameter, and each limb of which is about 6 m.m. in length with coils in proportion. All these electro-magnets are connected together and set in action by a speaking charcoal microphone. A Leclanché battery of three elements is sufficient.

Action of Hydracids on Mercury Sulphate and of Sulphuric Acid on the Haloid Salts of the same Metal.—A. Ditte.—Contrary to the statement of Berzelius hydrochloric acid does not decompose sulphate of mercury with expulsion of sulphuric acid, but combines with the salt in definite proportions. The compound formed dissolves in water without decomposition. A corresponding bromine compound is formed by heating mercuric sulphate in hydrobromic acid, or by heating a mixture of mercuric bromide and sulphuric acid. With iodine no analogous product is obtained.

Action of Platinum Wire on the Hydrocarbides.—J. Coquillion.—Hydrogen bicarbide mixed with air is more denotating than the protocarbide; palladium produces a feebler denotation than platinum; both these metals may equally serve for burning small quantities of gas at white redness.

Alkalinity of the Carbonates and Silicates of Magnesia, Free, Mixed, or Combined.—M. Pichard.—Magnesian carbonates, artificial or natural, have an alkaline reaction on litmus paper, and impart this property to mixtures in which they are present in the proportion of 1 part in a thousand. Natural silicates containing magnesia have also an alkaline reaction. The natural silicates of alumina, potassa, soda, and lime, both separately and associated, are perfectly neutral.

No. 22, November 25, 1878.

Critical Examination of a Posthumous Work of Claude Bernard on Alcoholic Fermentation.—L. Pasteur.—The author sums up his memoir as follows:—The manuscript of Bernard is merely a sterile attempt to substitute the deductions of an ephemeral system for well-established facts. He remarks that if M. Berthelot, to whom the publication of this posthumous work is due, had not been himself biassed by pre-conceived ideas, the work of the late illustrious physiologist would not have seen the light in its present form. Bernard's fundamental doctrine is the essential opposition between phenomena of vital creation or of organising synthesis, and, on the other hand, phenomena of death or of organic destruction, to which latter general type the actions of fermentation belong. M. Pasteur, on the contrary, maintains that under certain conditions there appear acts of fermentation in direct correlation with organic acts. Bernard's especial conception was that of soluble non-organised ferments, and he often declared that it was necessary to liberate fermentation from the vitality of cellules.

Reclamation of Priority on the Subject of M. Werdermann's Electric Lamp.—E. Reynier.—In a note laid before the Academy on May 13, the author explained the principle of a system identical with that which M. Werdermann has just proposed.

Novel Phenomenon of Static Electricity.—M. E. Duter.—The author describes an experiment proving that in certain cases electrisation may change the volume of bodies. In a Leyden jar the isolating matter undergoes on electrisation a dilatation which can be explained neither by an increase of temperature nor by electric pressure.

Subject of the Element called Mosandrum.—J. Lawrence Smith.—A reply to M. Marignac (*Comptes Rendus*, 1878, p. 281). The author claims the priority of having called the attention of the scientific world, in published documents, to the absence of ceric oxide and to the novel characters of certain earths existing in the mineral samarskite, and of having pointed out among them a new one, which he has named mosandrum.

Certain Derivatives of the Essence of Turpentine.—J. de Montgolfier.—The author has especially studied the action of sodium upon the hydrochlorates of terebenthin. From the solid hydrochlorate he has obtained inactive camphen, and a hydride of camphen of the formula $C_{20}H_{18}$. There was also produced in smaller quantity a third compound, probably the hydride of dicamphen. An examination of the products of the liquid mono-hydrochlorate is incomplete.

Cyanogen Derivative of Camphor.—A. Haller.—The author has prepared a compound having the formula of camphor, in which an atom of hydrogen is replaced by cyanogen.

Action of Salts of Chrome upon Salts of Aniline in Presence of Chlorates.—S. Grawitz.—Two years ago the extraordinary action of the salts of vanadium was pointed out. With aniline salts and in presence of

chlorates they determine the formation of black in the infinitesimal proportion of 5 milligrms. per litre of unthickened colour. Vanadium is rare and very dear, the bivanadate of ammonia being worth about 1500 francs per kilo. A substitute for it has been vainly sought without thinking of trying chrome, which is its nearest neighbour in the natural classification of the metals. But the chromic salts act with an energy still greater than that of the vanadic salts; 1-10th milligrm. of bichromate of potassa to 125 grms. of aniline salt dissolved in a litre of water develops the black. The experiment may be easily made by forming an ink and developing the black upon paper. In industrial practice the use of the chromates in place of the vanadates presents numerous advantages. The author wishes to call the attention of the Academy to this fact, because this reaction upon the salts of aniline in presence of the chlorates has been proposed as a qualitative test for vanadium. [It must be remembered that Lightfoot's original patent claims the use of "metallic salts and oxides" along with chlorates for the production of aniline blacks.—*Ed.* C. N.]

Biedermann's Central-blatt.
September, 1878.

Quantity of Ammonia and Nitric Acid in Atmospheric Precipitations.—Dr. W. Engling.—There is an evident idea that the proportion of combined nitrogen brought to the ground by rain is greater in the immediate neighbourhood of large towns than of the open country. In dry seasons the proportion of nitrogenised compounds is also greater than in wet periods. Elevated districts receive less copious, and therefore more nitrogenous, rains than the level country. The author is unable to accept Kayser's view of the non-existence of ozone in the air, and he is prepared to show that the colouration of the iodine-starch paper is not due to nitrous acid.

Carbonic Acid in the Air and Soil of Forests, as compared with that of the Open Country.—Prof. Ebermayer and Dr. Schwappach.—The air within an extensive forest contains in summer almost double the proportion of carbonic acid found over the open country. Forest-soil, on the other hand, is in summer very much poorer in carbonic acid than the soil of the open fields, and the amount in the latter rises with elevation of temperature much more rapidly than does the former. The diffusion of carbonic acid in the soil seems to be very slow, as it varies greatly in closely contiguous places.

Guarantee of the Value of Bone-Dust.—Prof. R. Heinrich and L. Hensolt.—The authors have examined the three classes of bones used in the manure-trade,—*i.e.*, (1) massive bones from the slaughter-house; (2) bones collected from house to house; (3) boiled bones from the glue-works. After determining the nitrogen and phosphoric acid in these varieties, they find—taking the price of phosphoric acid at 0·60 shilling per unit, and that of nitrogen at 1·80 shilling—the respective values of the three 11·62, 10·81, and 9·79 shilling per cwt., the difference amounting to nearly 20 per cent. Hence a guarantee of the genuineness of ground bones is insufficient unless their chemical composition is guaranteed also.

Manurial Experiments with Precipitated Phosphate of Lime and so-called "Reverted" Phosphoric Acid.—Prof. A. Petermann and Prof. L. Grandeau.—The authors conclude that the roots of plants take up the phosphoric acid of the precipitated phosphates, soluble in citrate of ammonia, as readily as the phosphoric acid of superphosphate soluble in water. This conclusion is still more applicable to the phosphates of iron and alumina, which in the author's experiments have given better results than precipitated phosphate of lime.

Preservation of Liquid Extract of Rennet.—Dr. F. Soxhlet.—The author finds thymol applicable for this purpose.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 12, November 21, 1878.

Tempered Glass.—M. F. Martial, of Ploermel, had placed a few grammes of sulphate of potassa with water in a capsule of this material, and, having set it upon his work-table, turned away to light a lamp, when the capsule burst into fragments with an explosion comparable to that of a fulminate. The observer then put the same quantity of sulphate of potassa and of water in another capsule of similar material, and succeeded in getting it to boil without accident.

MISCELLANEOUS.

Technological Museum for Sydney, New South Wales.—We are informed that the Government of New South Wales has requested Mr. William Forster, Agent-General for the Colony, Prof. Liversidge, of the University of Sydney, and Mr. E. Combes, M.P., C.M.G., to collect information in the United Kingdom and on the Continent relative to the working of English and Foreign Technological Museums and Colleges, with a view to forming similar institutions in Sydney. A sum of money has been placed on the estimates by the Government of the Colony, to enable the Committee to purchase suitable specimens. We have no doubt that the Agent-General for New South Wales (3, Westminster Chambers, S.W.) will be extremely glad to receive from such institutions, or from any other source, reports or any information which would assist the Committee in its enquiries.

NOTES AND QUERIES.

Distillation of Coal-Tar—Perhaps some of your numerous readers will kindly inform me of the best method of distilling coal-tar, and the way in which the different products are procured. Is there any good treatise on the subject? and, if so, who are the publishers?—K. J.

Soluble Blue.—Can any of your readers tell me the name, price, and where I may obtain a bright, non-poisonous, and *soluble* blue which will not be affected by *alkalies*.—Soluble Blue.

Hydraulic Cement.—It may be worthy of record that in some experiments with hydraulic and Portland cement I have found that the presence of silica is not essential. It may be replaced by boric acid, and possibly also by other materials. So far as my experiments go, the cement made with borate of lime and alumina, when finished with an ordinary tool, takes a very fine polish; this polish appearing naturally on the surface in a short time, after it is left moderately smooth by the tool.—Thos. Fletcher.

MEETINGS FOR THE WEEK.

Monday, Dec. 16th.—Medical, 8.
—— London Institution, 5.
—— Society of Arts, 8. "Mathematical Instruments," by W. Mattieu Williams.
Tuesday, 17th.—Civil Engineers, 8.
Wednesday, 18th.—Society of Arts, 8. "Science Teaching in Elementary Schools," by Dr. J. H. Gladstone, F.R.S.
—— Meteorological, 7.
—— Geological, 8.
Thursday, 19th.—Royal, 8.30.
—— Chemical, 8. "Researches on the Action of the Copper-zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe. "On the Formula of Glyoxylic Acid," by Dr. Debus. "On the Production of Oxides of Nitrogen by the Electric Arc in Air." by T. Wills. "On Baric Periodate," by S. Siguira and C. F. Cross. "On Erbium and Yttrium," by Dr. Humpidge and Mr. Burney.
—— Philosophical Club, 6.30.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

An Examination in Practical Chemistry in connection with the Institute of Chemistry will be held during the last week of January next. Examiner, Dr. W. J. Russell, F.R.S. Candidates can obtain further information on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London W.C.

THE CHEMICAL NEWS.

VOL. XXXVIII. No. 995.

THE CENTENARY OF THE BIRTH OF SIR HUMPHRY DAVY, DECEMBER 17, 1878.

THE day for passing eulogiums on Sir Humphry Davy has long since passed away. His name is known and honoured wherever science has penetrated or is penetrating. The reputation of Davy is spreading co-equally with the march of civilisation, and the white-turbaned softas of the Dar-ul-Founoun of Mohammedan Stamboul, the dusky students of the University of Brahman Benares, and the pigtailed votaries of the Imperial College at Buddhist Tokio are as rapidly becoming acquainted with the scientific achievements of the Cornish apothecary's apprentice as their more civilised fellow-workers on the banks of the Thames, the Seine, and the Spree. His fame is indissolubly united with substances and principles which lie at the very foundation of chemical theory and practice, and it would be as hopeless a task to attempt to separate the remembrance of his name from those little words potassium and sodium, chlorine and boron, as it would be to endeavour to deprive matter of molecular motion, or iron of its coercitive force. Instead, then, of celebrating the centenary of his birth by a string of laudatory platitudes or eulogistic commonplaces, we prefer to hold up his life and labours to the example of those of the rising generation of chemical students who desire to follow in his footsteps. It is not every one who has the desire or leisure, or indeed patience, to read through the diffuse biographies of this great man, which were published a short time after his death by his brother, Dr. John Davy, and his attached friend, Dr. John Ayrton Paris, or try to come at the facts of his life amongst the flowery periods of the *éloge*, which Baron Cuvier pronounced before the French Academy of Sciences on the occasion of his death. We think, therefore, it will not be out of place or season if we present our younger readers at any rate with a brief sketch of his career from his birth on the beautiful shores of Mount's Bay to his death on the no less lovely banks of Lake Leman. Before doing so we would remark that one of the most prominent features in Davy's character was *thoroughness*. Whatever we find him doing, whether it is making fireworks in his guardian's kitchen while yet a child, studying medicine and pharmacy under Dr. Borlase, fly-fishing for trout in Scotch or Carinthian lakes, or trying to split up potash and boracic acid into their constituent elements, we always find his distinguishing characteristic to be *thoroughness*. The voluminous collection of note-books which he left behind him are curiosities in this respect. Observations of every kind and sort are included in these pages. At one time he notes down a peculiarity of flight in a swallow, at another a philosophical or theological puzzle, at another the anomalous behaviour of certain reagents, with a view to further investigation; whatever, in fact, he observes, down it goes for future reference or consideration. Even when on what he thought was his dying bed he kept his brother John fully employed either in reading over to him the MS. of his "Last Days of a Philosopher," or when too ill to listen to him in dissecting torpedoes in the adjoining room. Whether he shot, or fished, investigated the secrets of nature, or engaged in controversy with obstinate or ungenerous opponents, he worked with all the intellectual might of his wonderful mind, with all physical strength of his hardy body.

Humphry Davy was the eldest son of Robert and Grace Davy, and was born at Penzance, on December 17, 1778. He was a strong, active, healthy child, with a very retentive memory. At six years old he was sent to a small reading and writing school at Penzance, but progressed so rapidly that his master, very disinterestedly, had him transferred to the town Grammar School, which was presided over by the Rev. Mr. Coryton. The Grammar School did not seem to have done him much good, as the principal was alternately indulgent and cruel, strict and careless. When he was nine years old he was taken charge of by a Mr. Tonkin, a friend of his mother's family, to whom she and her sisters were indebted for a father's care after the death of their parent.

Mr. Tonkin lived at Varfell, a small village situated in a beautiful part of Mount's Bay, and it was evidently during this period that he acquired that ardent love of the beauties of nature and of open-air sports, which were one of the chief pleasures of his happy life. In the intervals of study under Mr. Tonkin he was riding, fishing, shooting, gardening, or collecting and painting specimens of natural history or minerals; in fact, he does not seem to have worked very hard at his books during this period, and at one time appeared likely to grow into a sporting naturalist instead of a philosopher. When he was in his sixteenth year his father died, a sad event which seems to have had a great effect on him. He at once applied himself seriously to study; and on February 10, 1794, when only a few weeks over fifteen, he was apprenticed to Mr., afterwards Dr., Bingham Borlase, surgeon and apothecary, of Penzance. His note-books of the period show the ardour with which he began his work under Dr. Borlase. He drew up for himself an impossible course of study, comprehending almost every branch of knowledge, including the acquirement of no less than seven languages, his own profession, however, claiming the major portion of his time. His first MSS. now begin to appear, and, like those of many a clever youth of his age, were on theological, ethical, philosophical, and political subjects. He thus early showed the bias of his mind, and these fugitive productions, although boyish and incomplete, nevertheless contain the germs of the thoughts which at the close of his life he so eloquently expressed in the "Salmonia" and the "Consolations of Travel." He also began to write poetry *tant bien que mal*, a practice which he seems to have kept up almost to the day of his death. Samuel Taylor Coleridge said that if he had not been the greatest English chemist he would have been the greatest English poet, an opinion in which few critics will join. His verse is mellifluous, and the thoughts he intends to convey are always of a noble character, but the divine *afflatus* is entirely wanting.

In 1796 he took up the study of mathematics, and went through a severe twelve-months' course, thus evidently laying the foundation of that singularly exact and acute style of reasoning which he employed with such ability and success in upholding the elementary nature of chlorine against a cloud of opponents all fully worthy of his steel. In 1796 he began to study the Scotch metaphysicians, as well as Kant, and the Transcendalists; but it was not until the following year, when he had just passed his nineteenth birthday, that he took up physical science as a study. By the end of the year he added chemistry, using the works of Lavoisier and Nicholson. Like many another poor student he converted his bedroom into a laboratory, and thoroughly examined the materials he met with in his everyday work by the aid of a collection of phials, teacups, and tobacco-pipes, adjourning to Mr. Tonkin's kitchen whenever he had any crucible operations to perform. In 1797 he began to write his "Researches on Light and Heat," published a couple of years after, which attracted the attention of Dr. Beddoes, of Bristol, with whom he entered into a long correspondence, which ended in his converting the learned Doctor to his views. He was now pursuing his profession with the greatest perseverance, receiving the most valuable assistance in a scientific sense from his intimate intercourse with Mr. Gregory Watt, the son of the great James Watt, and with Mr. Davies Gilbert, who was his senior by some years

and well versed in the science of the day. With these companions he used to ransack the country for miles round for specimens of minerals, rocks, and fossils. He was also assisted greatly by being allowed to use two excellent libraries, one belonging to his master, the other to the Rev. Dr. Tonkin, the eldest brother of his friend and guardian.

Towards the end of the fourth year of his apprenticeship he received a proposal from Dr. Beddoes, at Bristol, to take charge of a newly-founded institution, called the Pneumatic Hospital, in which every ailment under the sun was to be cured by the inhalation of gases and vapours. He joyfully accepted this offer, for he had been thoroughly fascinated by experimental research, and Dr. Beddoes's institution was provided with a well-appointed laboratory. After working for a year presumably under Dr. Beddoes's direction he set up a private laboratory at his house at Clifton, which was the beginning of his independent researches. He now began the systematic study of all the then known gases and their physiological effects on the human frame. He also took up the study of the infant science of voltaic electricity, but his great research at this time was that which ended in the discovery of nitrous oxide. This was the turning-point of his career, and the fame of young Davy's discovery spread everywhere. While at Bristol, too, he seems first to have suspected the compound nature of hydrochloric, hydrofluoric, and boracic acids. He even tried to decompose certain metallic chlorides by passing the vapour of sulphur over them at a red-heat, but without success. He also tried to decompose hydrochloric acid gas by means of the electric spark, but also failed. One of his experiments nearly proved fatal. During some researches on the physiological effects of carburetted hydrogen he inhaled too large a quantity of the poisonous gas, and became so ill from the effects of it that he had to relinquish work for a time.

In 1801 he received a communication from Count Rumford, the founder of the Royal Institution, offering him the post of Assistant Chemical Lecturer, with the right of succeeding Dr. Garnett as Principal Chemical Lecturer whenever that gentleman—who was growing too old for the post—should think fit to retire, an event which happened in the year following. He consequently resigned his position at Bristol in February, 1801, and delivered his first lecture at the Royal Institution in the April following, in the presence of Sir Joseph Banks, Count Rumford, and all the scientific and literary celebrities of the day. He seems to have taken his audience completely by storm. His manner, his personal appearance, his intelligent countenance and sparkling eyes, his youth and simplicity, as well as his happy illustrations and well-chosen experiments, made him the pet of the hour, and Davy's Royal Institution Lectures soon became as fashionable as Almack's or the Ancient Concerts. His great reason for quitting his friend Dr. Beddoes, to whom he seems to have been much attached, was his passion for research, Count Rumford having promised him the sole and uncontrolled use of the Laboratory and apparatus of the Institution. He began at once by continuing the voltaic researches he had commenced at Bristol, an account of which he had published in *Nicholson's Journal*. Invitations to dinners, balls, and soirées now began to pour in upon him, and the handsome well-bred philosopher became the rage. During his stay at the Royal Institution he seems to have seldom burned the midnight oil. He worked hard during the day, and devoted the evening to social intercourse with the aristocracy of birth and brain, with all the thoroughness of his nature. During the recesses he used to rush off to Wales, Scotland, or to any other part of Great Britain where his beloved trout could be found. He explored most parts of England in this way, always, however, bringing back with him well-filled cases of mineralogical, geological, and rock specimens. The chemistry of agriculture at this time greatly engaged his attention, and in 1802-3 he gave a series of lectures on the subject at the request of the Board of Agriculture, which were afterwards published, in 1813, under the title of the "Elements of the Chemistry of Agriculture." Amongst his first work at the Royal Institution was a series of researches into the properties of catechu as a tanning material; but voltaic electricity and electro-chemical science, as well as the analysis of rocks and minerals in relation to geology and agriculture, took up most of his time. But the day was fast approaching when he was to make his indelible mark on the chemistry of his own and all future time. His first Bakerian Lecture was delivered in November, 1806, in which he laid down the laws of electricity in relation to chemical combination; his second Bakerian Lecture, in the following November, giving in the results of the application of these laws the amplest confirmation of their truth. His career for the next six years was a simple triumphal march of discovery. His papers on numerous subjects, each containing a crop of new discoveries, flowed into the Royal Society's archives in an uninterrupted stream; and it may be said, without exaggeration, that his work during the six years from 1806 to 1812 did more for chemistry than the sixty which followed them. There has hardly been a single discovery made during the last sixty or seventy years which is not in some way or other the more or less direct consequence of Davy's work during this time. These discoveries are too well known to need recapitulation here: they are to be found in the first hundred pages of every half-crown Chemical Text-Book.

In 1810 and 1811 his fame spread to Ireland, and he was invited to Dublin to give two courses of lectures in those years. He received 400 guineas for the first course, and 700 guineas for the second. In the last-named year he had a strange fancy for continuing his medical studies, and even kept terms at Cambridge in preparation for taking his degree, but science after all had too many charms for him, and he relinquished his intention. Oddly enough, too, some of his influential friends tried to persuade him to enter the Church, promising him speedy preferment, but he declined. In 1812 he married a widowed lady of ample fortune—a Mrs. Appreece—with whose charms of body and mind he was greatly enamoured. A few days before his marriage he was knighted by the Prince Regent at a levée. Immediately after his marriage he resigned his position at the Royal Institution, and although he was elected Honorary Lecturer, he announced his intention of giving no more routine lectures. He considered, no doubt, that he had done enough drudgery, and that the discoveries he had made were sufficient to prevent his being considered a *dilettante* if for the future he followed up only those special lines of research which he had long before laid out for himself. Henceforth he was no longer a paid servant, but a willing volunteer fighting for the glory and advancement of science. We may mention, *en passant*, that after the delivery of his greatest Bakerian Lecture—the second, in which he announced the discovery of the elements potassium and sodium—he utterly broke down from over-excitement and hard work. He was seized with a feverish attack that seriously threatened his life in 1807, and did not resume work until the following March, when he commenced a series of lectures on electro-chemical science.

Shortly after his marriage he published his "Elements of Chemical Philosophy," dedicated to his wife, which was immediately translated into half a dozen continental languages.

In March, 1813, Sir Humphry Davy appointed Michael Faraday assistant in the laboratory of the Royal Institution, and in the following year took him abroad with him as his amanuensis.

From this time forward his life was one happy round of travel in England and on the Continent, always accompanied by his gun and his book of flies; balls, parties, and court receptions, and occasional brilliant scientific discoveries. The year following his marriage, while experimenting on nitrogen trichloride, in his friend Mr. Child-

ten's laboratory at Tunbridge, he met with a serious accident, which at one time threatened to destroy his sight. In 1813 we find him hard at work trying to decompose the fluorides, his labours resulting in the discovery of hydro-fluoric, silico-fluoric, and fluo-boric acids. In 1813 he visited the Continent for the second time, passing through Paris, where he proved to the whole of the French Academy that iodine was an element. The April following found him at Florence investigating the nature of the diamond, which he proved to be nothing more than an allotropic form of carbon. In 1814 and 1815 he does not seem to have done much beyond examining some ancient colours, and discovering chloric and iodic acids, and working on their salts.

The year 1815 was a fruitful one, although it contains only one discovery, that of the safety-lamp, to which his name is indissolubly connected. Returning in August from an excursion in Scotland, through the coal districts, he was painfully interested at the loss of life in coal-mines occasioned by the explosions of fire-damp. He had specimens of fire-damp from different coal-mines collected and sent up to him in London, and on the 9th of November he sent in two papers on the subject to the Royal Society, the lamp being perfected in the following month. This invention he gave freely to the world; had he patented it his gains would have been incalculable. In 1817 he was presented with a service of plate worth £2500 by the coal-owners and miners of England and Scotland, and shortly after he received the honour of baronetcy. The possibility of unrolling the Herculaneum papyri next engaged his attention, and he published some observations on the phenomena of volcanoes and on Oersted's electro-magnetic experiments. In 1820 he succeeded Sir Joseph Banks as President of the Royal Society, a post which he retained for seven years. He did little more remarkable work from this time forward, his last remarkable papers being those on the preservation of copper-sheathing from corrosion by voltaic means and the Bakerian Lecture for 1826, on the relation of electric and chemical changes, which may be said to be the crowning point of his brilliant career.

In 1825 he fell into ill-health, and symptoms of a paralytic nature began to manifest themselves. His illness was greatly aggravated by the unexpected death of his mother in the September of the next year, and at the end of November he had a severe paralytic seizure which greatly affected his right side. He consulted the first physicians of the day without relief; but Nature, for whom he had done so much in unfolding her wonders, came to his assistance, and he soon gained sufficient strength to correct the proof-sheets of his collection of discourses before the Royal Society.

In the spring of 1827 he started for Italy, in company with his brother, and wandered about pleasantly until the October of that year, when he returned to England. In March, 1828, he once more started for his favourite Carinthia, travelling through Switzerland and Italy, and bringing up at Rome in February, 1829.

During the whole of his travels he was at work on his "Salmonia" and "Consolations of Travel," besides making numberless observations on torpedoes, the effects of voltaic electricity on muscle and nerve, and a crowd of notes on various interesting points in natural history.

He had barely arrived in Rome when he had a paralytic seizure which rendered his right side quite powerless. His brain, however, was quite unimpaired, and on the 25th of February he dictated a letter to his faithful brother John, who was Naval Surgeon at Malta. In those days Malta was nearly three weeks' journey from Rome, and he did not arrive till the 14th of March, when the illustrious patient had so far recovered as to be able to drive out. In April, Lady Davy arrived in Rome from London with the second edition of the "Salmonia," the sight of which seemed to revive him wonderfully. On the 30th of April he left Rome for Geneva, where he arrived on May 28th, apparently greatly enlivened and improved by his journey, but at two o'clock on the following morning his brother was roused up and reached his bedside only just in time to receive his last sigh. At his own request he was buried in the cemetery outside the walls of the city in which he died.

THE NATURE OF THE ELEMENTS.

At a crowded meeting such as is seldom witnessed of the Royal Society on Thursday evening last Mr. J. Norman Lockyer, F.R.S., read a lengthy paper, in which he discussed the evidence derived from spectroscopic observation of the sun and stars and from laboratory experiments, which has led him to the conclusion that the so-called elements of the chemist are in reality compound bodies. In order that the line of argument followed by Mr. Lockyer may be understood, it will be necessary briefly to refer to the results of previous researches. As a rule, in observing spectra the substance to be examined is volatilised in a gas flame or by means of sparks from an induction coil, and the light is allowed to fall on the slit of the spectroscope; the spectrum is then generally one in which the lines run across the entire field, but by interposing a lens between the spark apparatus and the slit of the spectroscope, Mr. Lockyer was enabled to study the various regions of the heated vapour, and thus to establish the fact, already noted by some previous observers, but to which little attention had been paid, that all the lines in the spectrum of the substance volatilised did not extend to equal distances from the poles. He then showed by the aid of this method that in the case of alloys containing different proportions of two metals, if the one constituent were present in very small quantity its spectrum was reduced to its simplest form, the line or lines longest in the spectrum of the pure substances alone appearing, but that on increasing the amount of this constituent its other lines gradually appeared in the order of their lengths in the spectrum of the pure substance. Similar observations were made with compound bodies. It was also noticed that the lines furnished by a particular substance varied, not only in length and number, but also in brightness and thickness according to the relative amount present. Armed with these facts and with the object of ultimately ascertaining more definitely than has hitherto been possible which of the elements are present in the sun, Mr. Lockyer about four years ago commenced the preparation of a map of a particular region of the spectra of the metallic elements for comparison with the map of the same region of the solar spectrum. For this purpose about 2000 photographs of spectra of all the various metallic elements have been taken, and, in addition, more than 100,000 eye observations have been made. As it is almost impossible to obtain pure substances, the photographs have been carefully compared in order to eliminate the lines due to impurities; the absence of a particular element as impurity being regarded as proved if its longest and strongest line was absent from the photograph of the element under examination. The result of all this labour, Mr. Lockyer states, is to show that the hypothesis that identical lines in different spectra are due to impurities is not sufficient, for he finds short line coincidences between the spectra of many metals in which the freedom from mutual impurity has been demonstrated by the absence of the longest lines. He then adds that five years ago he pointed out that there are many facts and many trains of thought suggested by solar and stellar physics which point to another hypothesis—namely, that the elements themselves, or, at all events, some of them, are compound bodies. Thus it would appear that the hotter a star the more simple is its spectrum; for the brightest, and therefore probably the hottest stars, such as Sirius, furnish spectra showing only very thick hydrogen lines and a few very thin metallic lines, charac-

teristic of elements of low atomic weight; while the cooler stars, such as our sun, are shown by their spectra to contain a much larger number of metallic elements than stars such as Sirius, but no non-metallic elements; and the coolest stars furnish fluted band spectra characteristic of compounds of metallic with non-metallic elements and of non-metallic elements. These facts appear to meet with a simple explanation if it be supposed that as the temperature increases the compounds are first broken up into their constituent "elements," and that these "elements" then undergo dissociation or decomposition into "elements" of lower atomic weight. Mr. Lockyer next considers what will be the difference in the spectroscopic phenomena, supposing that A considers B as an impurity and as a constituent. In both cases A will have a spectrum of his own. B, however, if present as an impurity, will merely add its lines according to the amount present, as we have above explained; whereas if a constituent of A, it will add its lines according to the extent to which A is decomposed and B is set at liberty. So that as the temperature increases the spectrum of A will fade if A be a compound body, whereas it will not fade if A be a true element. Moreover, if A be a compound body, the longest lines at one temperature will not be the longest at another. The paper chiefly deals with a discussion from from this point of view of the spectra of calcium, iron, hydrogen, and lithium as observed at various temperatures; and it is shown that precisely the kind of change which is to be expected on the hypothesis of the non-elementary character of the elements has been found to take place. Thus each of the salts of calcium, so long as the temperature is below a certain point, has a definite spectrum of its own, but as the temperature is raised the spectrum of the salt gradually dies out, and very fine lines due to the metal appear in the blue and violet portions of the spectrum. At the temperature of the electric arc the line in the blue is of great intensity, the violet H and K lines, as they are called, being still thin; in the sun the H and K lines are very thick, and the line in the blue is of less intensity than either, and much thinner than in the arc. Lastly, Dr. Huggins's magnificent star photographs show that both the H and K lines are present in the spectrum of α Aquilæ, the latter being, however, only about half the breadth of the former; but that in the spectrum of α Lyræ and Sirius only the H line of calcium is present. Similar evidence that these different lines may represent different substances appears to be afforded by Professor Young's spectroscopic observations of solar storms, he having seen the H line injected into the chromosphere 75 times, the K line 50 times; but the blue line, which is the all-important line of calcium at the arc-temperature, was only injected thrice. In the spectrum of iron, two sets of three lines occur in the region between H and G which are highly characteristic of this metal. On comparing photographs of the solar spectrum and of the spark taken between poles of iron, the relative intensity of these triplets is seen to be absolutely reversed; the lines barely visible in the spark photograph being among the most prominent in that of the solar spectrum, while the triplet, which is prominent in the spark photograph, is represented by lines not half so thick in the solar spectrum. Professor Young has observed during solar storms two very faint lines in the iron spectrum near G injected 30 times into the chromosphere, while one of the lines of the triplet was only injected twice. These facts, Mr. Lockyer contends, at once met with a simple explanation if it be admitted that the lines are produced by the vibration of several distinct molecules.

The lithium spectrum exhibits a series of changes with a rise of temperature precisely analogous to those observed in the case of calcium.

In discussing the hydrogen spectrum, Mr. Lockyer adduces a number of most important and interesting facts and speculations. It is pointed out that the most refrangible line of hydrogen in the solar spectrum, *h*, is only seen in laboratory experiments when a very high temperature is employed; and that it was absent from the solar protuberances during the eclipse of 1875, although the other lines of hydrogen were photographed. This line, also, is coincident with the strongest line of indium as already recorded by Thalèn, and may be photographed by volatillising indium in the electric arc, whereas palladium charged with hydrogen furnishes a photograph in which none of the hydrogen lines are visible. By employing a very feeble spark at a very low pressure the F line of hydrogen in the green is obtained without the blue and red lines which are seen when a stronger spark is used, so that alterations undoubtedly take place in the spectrum of hydrogen similar to those observed in the case of calcium. In concluding this portion of his paper Mr. Lockyer states that he has obtained evidence leading to the conclusion that the substance giving the non-reversed line in the chromosphere, which has been termed *helium*, and not previously identified with any known form of matter, and also the substance giving the 1474 or coronal line, are really other forms of hydrogen, the one more simple than that which gives the *h* line alone, the other more complex than that which gives the F line alone.

There can be no question that the facts brought forward by Mr. Lockyer are of the highest importance and value, and that they will have much influence on the further development of spectrum analysis, to which he has already so largely contributed. But his arguments are of a character so totally different from those ordinarily dealt with by chemists that they will hesitate for the present to regard them as proof of the decomposition of the elements until either they are assured by competent physicists that they cannot be explained by any other equally simple and probable hypothesis, or until what Mr. Lockyer has foreshadowed as taking place to such an extent in other worlds has been realised beyond question or cavil in our own laboratories. It has been suggested that the same molecule may be capable of vibrating in different ways at different temperatures, and thus of yielding different spectra, just as a bell may give out different notes when struck in different ways; and although Mr. Lockyer has replied to this objection, it can scarcely be regarded as finally disposed of. The fact, however, as Mr. Lockyer has pointed out, that the change from the spectrum of a compound to the lowest temperature spectrum of its metallic element is of a similar character to and even less in degree than the change from the lowest temperature spectrum of the metal to the spectra which it furnishes at higher temperatures does not appear to favour such an hypothesis, and from the similarity in the phenomena it is difficult to deny that in both cases decomposition does not equally take place. Professor Young's observations on the injection of particular lines into the chromosphere during solar storms are also difficult to reconcile with this view, and if the conclusions drawn from previous researches are correct, it also does not account for the short line coincidences which led Mr. Lockyer to his hypothesis.

Chemists are careful to teach that what are at present regarded as elements are not necessarily simple bodies, but merely substances which they are unable to decompose or which they have no special reason to regard as compound bodies. The remarkable relations, both in atomic weight and properties, existing between many of the elements tend, indeed, to show that they are related in the manner Mr. Lockyer supposes. We sincerely hope that he will continue his researches in this direction, and we trust that at no very distant time he may be able to bring forward evidence sufficiently clear to convince even the most sceptical.—*The Times, Dec.* 18.

The "Gros" Telegraph.—This instrument, now under official trial in the department of Aveyron, announces automatically any rise of a river, so that the inhabitants lower down the valley may be instantly warned. —*Moniteur Scientifique.*

ON THE

METHOD OF EXTRACTING GOLD, SILVER, AND OTHER METALS FROM PYRITES.*

By W. A. DIXON, F.C.S., Cor. Mem. Nat. Hist. Soc. Glasgow.

(Continued from p. 283).

It is difficult to account for the fact that in the case of the more complex mineral the chlorine even in large excess exerts so little action on the gold, and that when all the copper has been removed previous to treatment; but in every trial similar results were obtained. It seems probable, however, that the state of aggregation of the metal has some influence on its solubility in chlorine, and that as a mispickel dissolves gold, it was therefore obtained in the residue in a finely divided state, less so in the iron pyrites residue, and least divided in the complex ore. In the last, mere traces of gold were obtained by re-treating the residues from the first treatment by chlorine.

The only other salts of gold which possess sufficient stability to render their use possible for its extraction are the auricyanides of the alkali metals and bromide of gold. Bromine would, however, be more expensive and more troublesome to use than chlorine, and moreover in one or two trials gave me smaller results than were obtained by chlorine. Skey† has described a method of testing for gold by the use of bromine water, and also with tincture of iodine. I have been unable to obtain any reaction either with tincture of iodine or with solution of iodine in iodide of potassium, which, considering the unstable character of the gold iodides, is scarcely to be wondered at.

Prince Balgration and Elsner‡ have observed that precipitated gold is soluble in cyanide of potassium if exposed to the air, and the latter says also in ferrocyanide of potassium. A patent was applied for in America in 1868 for the use of cyanide of potassium for the extraction of gold from its ores, but I have no particulars of the process. It seemed to me, however, that the high price of this salt, its instability when exposed to the air and in solution, and its extremely poisonous properties, precluded its use for this purpose. On trying the reaction between precipitated gold and cyanide of potassium, I found that it was extremely slow if the gold was at all dense. In presence of alkaline oxidising agents, however, I found that the solution of the gold was sufficiently rapid. Thus, on standing overnight, the quantity of gold and cyanide of potassium solutions being similar in each case—with the cyanide alone, traces only of gold were dissolved, but with the addition of calcium hypochlorite, ferrocyanide of potassium, or binoxide of manganese, all the gold was dissolved; with chromate of potassium, a small quantity; with permanganate of potassium, none.

With ferrocyanide of potassium alone I did not obtain any gold in solution after standing some days, but I thought that with suitable oxidising agents it might be obtained in solution according to the equation—

$$4Au + 2K_4FeCy_6 + 7O + 4H_2O = 4AuCy_3 + Fe_2O_3 + 8KHO.$$

In the cold, however, with the exception of ferricyanide of potassium, none of the above oxidising agents had any effect, but heated to 212° F. the reaction with all of them was sufficiently rapid, and I found that this was also the case with permanganate. This reaction promised to be of considerable value, as the gold and silver would both be obtained in solution, from which the former could be precipitated by filtering the hot solution through finely divided metallic silver, of which an equivalent quantity would be dissolved, which, with the silver originally present, could be precipitated as sulphide. By treating the solution with ferrous hydrate, the cyanide of potassium could be retransformed into ferrocyanide, which has the important advantages of being exceedingly stable and non-poisonous. I found, however, that copper in any form precipitated both gold and silver from the solution, or at all events that these metals were not dissolved until the copper had all gone into solution; also, that if the copper was present as sulphide, the silver was transformed into sulphide which is insoluble. Any copper dissolved cannot be precipitated as sulphide, but I found that it could be removed by digesting the solution with ferrous hydrate, the solution being kept alkaline.

A portion of roasted arsenical pyrites was digested at 212° for twelve hours with ½ oz. ferrocyanide of potassium, 32 grs. oxide of manganese (20 lbs. per ton), and sufficient water made alkaline by soda to make a cream—the solution yielded 9 ozs. 8 dwts. 19 grs. gold per ton, leaving 1 oz. 9 dwts. 15 grs. This was the best result obtained with this pyrites, the yield with other oxidising agents and by more prolonged digestion being all somewhat lower.

With Mariner's Reef pyrites trials were made with each oxidising agent in succession, the duration of the digestion being varied from twelve to fifty-six hours; whilst with the soluble oxidising agents the quantity used was in some cases little over the theoretical amount, and sometimes ten times as much. In some of the experiments all the oxidising agent employed was added at once, in others at successive intervals; and I found that after four or five times the theoretical quantity had been added, a further increase had little or no influence on the result. With binoxide of manganese, on the other hand, from thirty-five to forty times the theoretical quantity gave the best results. The material used had been roasted with salt and extracted with acid, and contained so little copper that 50 grs. digested with nitric acid, the solution made alkaline by ammonia, and made up to 50 c.c., had only a faint colouration in a cylinder 3 inches deep. It contained—

	ozs.	dwts.	grs.
Gold	8	0	19
Silver	49	11	5

and yielded from 3 ozs. 12 dwts. to 5 ozs. 1 dwt. of gold, and from 46 ozs. to 46 ozs. 3 dwts. of silver per ton. This showed that all the silver which had been converted into chloride during the roasting was obtained in solution as cyanide. With the gold, on the other hand, all the results showed that with complex pyrites a portion only could be obtained in solution either in mercury or in water as cyanide or chloride, whilst none could be obtained as sulphide.

There being therefore no method by which the precious metals could be removed and the base metals left, it remained to fall back on one of the first principles of metallurgy, viz., to remove the base metals at the earliest stage possible, and leave the precious metals as a residue. In ordinary metallurgic operations this end is attained by dressing and successive smeltings. I however arrived at the conclusion that smelting was not a desirable process, as it is expensive, and the gold and silver would at last be found alloyed with a large quantity of copper, whilst considerable quantities of these metals would be lost by volatilisation and in the slags. These losses have been found elsewhere to be large, even when tested against the usual assay, which as Rivot observes is itself open to losses. That the loss of gold by any process involving smelting must be considerable is evident, when we consider that glass will hold a large amount of gold in solution. Thus, calculating from the quantity of gold used to form ruby glass, which is perfectly colourless when first melted, I find that it contains 10·88 oz. of gold per ton, imitation topaz 8·21 oz. of gold per ton, imitation garnet 27·18 and 46·33 ozs. per ton, by two different receipts. The gold is added in the form of purple of Cassius, that is, finely divided metallic gold mixed with oxide of tin; this usually contains 30 per cent. of gold which I

* Read before the Royal Society of N.S.W., August 1, 1877.
† CHEMICAL NEWS, xxii., 245.
‡ "Watts's Dictionary,": Cyanides of Gold.

have taken in calculating the above numbers, or of chloride of gold—an oxidising agent being added at the same time. In smelting operations the ferric oxide would act as an oxidising agent, and when once in solution it seems improbable that any practicable amount of smelting in presence of other metals would reduce and collect all the gold.

Thinking, however, that in spite of these objections a process of smelting was the only one which was likely to be successful, I turned my attention to the removal of the copper, so that I might obtain it separate from the gold and silver. Although many wet extraction processes have been used with success elsewhere, none of them appear to be quite suitable to the circumstances obtaining in these colonies. Perhaps the most successful has been the Longmaids' process as improved by Henderson, and so far as the recovery of gold and silver are concerned by Claudet. Worked in Great Britain, it has rendered available immense quantities of copper ores too poor to be treated by any other method; but there salt costs from 10s. to 15s. per ton, whilst here it is seldom less than £3. Their scrap iron is cheap; here if consumed in any quantity it would be very expensive, whilst inland carriage would immensely add to the cost of both. Again, in Great Britain the sulphur in the ores being used for the manufacture of sulphuric acid, it pays the whole or the greater part of the mining and carriage and the whole cost of the preliminary preparation and roasting, whilst the residual oxide of iron free from copper and sulphur is nearly of the value of hæmatite for fettling puddling furnaces; here both would be valueless.

With regard to Claudet's process for extracting the small quantity of gold and silver obtained in solution along with the copper by precipitation with iodide of zinc, the very small cost of which (9d. per ton of ore) has been noticed in the report of the Victorian Commission appointed to inquire into the treatment of pyrites, and others, I may note that this is only the *additional* cost of extracting those metals beyond that incurred in extracting the copper. It is only applicable to ores containing minute quantities of gold, and besides it is requisite that the whole of the copper be in solution as cupric chloride, as otherwise cuprous iodide is precipitated. As the formation of cupric chloride involves the use of more salt and its precipitation of more iron than cuprous chloride, the process has been abandoned in many places where tried.

(To be continued)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

December 14, 1878.

Prof. W. G. Adams, President, in the Chair.

Mr. W. Gleed and Mr. J. G. McGregor were elected Members of the Society.

Prof. Guthrie read a note by Mr. C. Boys "*On a Condenser of Variable Capacity.*" This condenser was designed for use in connection with the Holtz electrical machine to show the effect of condensation on the length of the spark. It consists of a test-tube coated externally with tin-foil to form the inner armature, and a glass tube enclosing the test-tube, and having its outer surface covered with tin-foil for the outer armature. The inner tube can be slid out or in along the length of the external tube, and the capacity thereby varied. Prof. Guthrie showed that a spark from the Holtz machine could by its means be gradually reduced.

Prof. Macdonnel stated that he had for some years used a similar apparatus, the inner coating, however, being strong sulphuric acid.

Dr. O. J. Lodge exhibited a differential thermometer in which saturated water vapour takes the place of air or other gas. This application is based on the fact that the pressure of a saturated vapour in contact with its liquid depends only on the temperature. An ordinary cryophorus answers the purpose when held so that the water occupies part of one bulb and a part of the stem next it: the greater the length of the water-column in the latter, that is, the more horizontal the cryophorus is held, the greater the sensitiveness of the instrument. When both bulbs are at one temperature the water in tube and bulb is at one level. If now there be a difference of temperature between the two bulbs there will be a difference of pressure in the vapour in their interiors, and the level of the water will change until the pressure is equilibrated. Unlike air-thermometers, the sensitiveness does not depend on the size of the bulbs or tube, and there is no increase of volume of the vapour. Another form consists of a U-tube with bulbs at the end of each arm, each bulb having some liquid, and the bend of the tube containing a short column of it, or, for greater sensitiveness, a series of films across the tube like diaphragms. This thermometer is found to be correct for temperatures below that of the ordinary temperature of the water and vapour, but inexact for high temperatures. With these latter the vapour-tension is not the same throughout the tube, and distillation is set up. The instrument is a much more sensitive thermoscope than the air thermometer, and there is almost no limit to its sensitiveness to low temperatures. The radiation from the hand held 6 inches from it sensibly affects it, as also does the radiation from a piece of ice. For class purposes it is likely to be useful from its simplicity and range of delicacy.

Mr. W. Clark, Cooper's Hill College, from a series of experiments which he is making on the surface-tension of liquid gases by means of their capillarity, gave the surface-tension of sulphurous anhydride as 2·3 milligrms. per square millimetre at −15° C.

The meeting then adjourned until January 25, 1879.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 29, 1878.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"*Note on certain Thionates*," by E. J. Bevan, Student in the Owens College. Communicated by Professor H. E. Roscoe, F.R.S., &c.

Thallium Trithionate. — When thallium carbonate is treated with an equivalent quantity of trithionic acid, prepared by precipitating potassium trithionate with tartaric acid, and the aqueous solution so obtained evaporated over strong sulphuric acid, thallium trithionate separates out in long colourless needle-shaped crystals isomorphous with those of the corresponding potassium salt. Thallium trithionate decomposes slowly at the ordinary temperature, quickly on heating, and is with difficulty prepared free from sulphate. Analysis showed it to contain 68 per cent of thallium, whereas the formula $K_2S_3O_6$ requires 67·95 per cent.

Hypovanadic Dithionate.—If an aqueous solution of barium dithionate be precipitated with the requisite quantity of hypovanadic sulphate, and the blue filtrate from the barium sulphate concentrated in a vacuum over strong sulphuric acid, crystals of hypovanadic dithionate separate out. If concentration be continued after the first appearance of these crystals decomposition takes place, sulphur dioxide is set free, and hypovanadic sulphate remains. This easy decomposition prevents hypovanadic dithionate being prepared in the pure state.

Aniline Dithionate.—This salt is obtained in beautiful

long needles, by the double decomposition of barium dithionate with aniline sulphate. Aniline dithionate is comparatively stable; its aqueous solution may be boiled without decomposition; when the dry salt is cautiously heated in a vacuous tube it sublimes, a portion, however, undergoing decomposition. It is freely soluble in water and alcohol; 100 c.c. of water at 16° dissolve 7·89 grms. of the salt. Its alcoholic solution, treated with sodium amalgam, yields aniline sulphite. Analysis showed this body to contain 18·60 per cent of sulphur, whilst $(C_6H_3NH_2)_2H_2S_2O_1$ requires 18·40 per cent S.

"*On some Improved Methods of Producing and Regulating Electric Light*," by Mr. Henry Wilde.

Among the manifold functions which the elementary substance carbon performs in organic nature, not the least important is that by which it becomes the great source of artificial illumination, whether derived from oils, coal-gas, or from coke rendered incandescent by the action of powerful electric currents. Since the time when Davy first produced the voltaic arc, between two points of wood-charcoal, through which was transmitted the current from the great battery of 2000 plates belonging to the Royal Institution, many experiments have been made to determine the best kinds of carbon for developing the electric light. The carbon which, until recently, was most commonly employed for this purpose is obtained from the sides of gas-retorts, where it accumulates in the form of coke during the destructive distillation of coal. The shells of coke from the retort are sawn up into pencils from one quarter to half an inch square, and from 6 to 9 inches in length. Although very good results are obtained from carbon of this kind, it is a difficult material to work on account of its hardness, and it sometimes contains impurities which interfere with its conductivity. It is also liable to fracture when suddenly heated by the transmission of powerful electric currents. These defects have led to the introduction in electric lighting of artificial carbon, composed of powdered coke and lampblack, formed into a paste with molasses and gum. This material is pressed into cylindrical forms, and subjected for a given time to a high temperature in a special furnace. The manufacture of these carbon pencils has attained great perfection in the hands of Carré, of Paris, and they can be made into perfectly straight and cylindricals forms of from two to sixteen millimetres in diameter and half a metre in length.

When the electric light is to be used for illumination, it is necessary that it should be as continuous as other modes of lighting. For this purpose not only should the current be regular in its action, but the distance between the carbon points must not alter, which necessitates the use of some arrangement for bringing them nearer together in proportion as they are consumed. Much ingenuity has been displayed by electricians in solving this problem, and the automatic contrivances invented by Staite, Duboscq, Foucault, Serrin, and others, leave little to be desired in regard to the steadiness of the light, when the regulators are in good order and in the hands of intelligent operators. All automatic instruments, however, from the delicacy of their mechanism, are liable to derangement, and their action is not easily understood by persons not having a special knowledge of their construction. To obviate the objection to the use of such instruments by unskilled attendants, I devised, a few years since, a regulator for use on H.M.'s ships of war, to be actuated by hand. In this arrangement the carbons are made to approach and separate from each other by means of a right- and left-handed screw connected with the carbon holders. Each of the screws, with its carbon holder, can be actuated independently of the other, for the purpose of adjusting the points of the carbons to the proper focus of the optical apparatus used in connection with it. The regulator, with its carbon points, is placed in the focus of a dioptric lens, which parallelises the divergent rays of light into a single beam of great intensity. The lens with the regulator is pivoted horizontally and vertically on the top of a short iron column, fixed on a raised platform above the deck, and the beam of light may be projected upon any distant object within its range. This special application of the electric light, however, as will be seen, requires the frequent adjustment of the carbons by the operator; but as he is always required to be in attendance to manipulate the projector, no inconvenience is experienced through the absence of the automatic arrangement. This method of regulating the electric light has now been in use in the Royal Navy for more than three years, and has proved very satisfactory.

Simultaneously with the progress of improvements in the mechanism for regulating the electric light, experiments have been made with the object of dispensing with the regulator altogether. The most recent, as well as the most successful, of these attempts has been made by M. Jablochkoff, a Russian inventor. In the specification of his letters patent of 1877 he proposes to place the carbons side by side (as had been previously proposed by Werdermann in 1874), and to separate them by an insulating substance to be consumed along with the carbon. The inventor states that the insulating substance for separating the carbons may be kaolin, glass of various kinds, alkaline earths, and silicates, which he prefers to apply in the form of powder rammed into an asbestos cartridge case containing the carbons. A powder which the inventor found serviceable consists of one part lime, four parts sand, and two parts talc. These materials are rammed into the cartridge case surrounding and separating two parallel sticks of carbon placed in the case at a little distance apart. One of the carbons is made thicker than the other to allow for its more rapid waste. The lower ends of the carbons are inserted into pieces of copper tube or other good conductor, separated from one another by asbestos, and the ends of the tubes are pinched between two limbs of a screw-vice, connected respectively to the conducting wires. This combination of carbons and insulating materials the inventor terms an electric candle, which, when mounted on a stand or candlestick, has the appearance of the Roman candle of pyrotechnists. The inventor further states that the heat produced by the electricity fuses the material between the carbons and dissipates it; and the freedom of the passage afforded by the fused material to the electric current permits the subdivision of the light by placing several lamps in the course of one electric circuit. It is also stated that the construction of the candle may be varied; and, among the forms described, is one in which the carbons, instead of being contained in a cartridge case, are separated by a partition of kaolin or other similar insulating material.

I have thought it well to describe, as nearly as possible in the words of the inventor, the electric candle, which is now the subject of so much attention in its application to electric lighting, so that its relation to what follows may be more clearly perceived. A remarkable peculiarity of the direct current in electric lighting is that of its consuming the positive carbon at twice the rate of the negative one; and while the negative carbon is a pointed cone, like that of a pencil, the positive pole takes the form of a hollow cavity or crater.

M. Jablochkoff's early experiments seem to have been made with the direct current, and hence his carbons are described as being of unequal thickness in order that the positive and negative carbons of the candle might be evenly consumed. When the alternating current is used for producing electric light both carbons are of the same thickness, and are consumed at an equal rate, and both points terminate in regular cones. This property of the alternating current, besides other advantages, always maintains the luminous point in the focus of any optical apparatus used in connection with it, that is, when the carbons are placed end to end, as I had occasion to point out in a former paper read before the Society in 1873, "On an Electro-Magnetic Induction Machine for producing Alternating Currents."

M. Jablochkoff, in the course of his experiments, would

appear to have met with some difficulties in adapting the direct or continuous current to a system of lighting with his electric candles, and now uses the alternating current for this purpose. The candle has also been simplified by substituting a slip of plaster of Paris for the cartridge and partition of kaolin formerly employed.

To produce the alternating currents, however, to supply a number of lights, it was found necessary to employ powerful electro-magnetic induction machines, excited by the currents from other smaller machines, according to the principles laid down in my paper read before the Royal Society, and published in the *Philosophical Transactions* of 1867. From sixteen to twenty lights are produced from one of these electro-magnetic machines, each light absorbing about one horse-power.

The system of electric lighting above described would now seem to be definitely established in some places as a substitute for gas, and visitors to the French capital during the present summer will have been struck with the fine effects produced in the avenues and squares where the light is displayed.

My connection with the history of this system of lighting placed me in a position to make some experiments with the Jablochkoff candle, and led to the discovery of the following facts. One of the conditions necessary for producing a constant light from the candle, in its most recent form, was that the quantity and intensity of the alternating current should be such that the carbons consume at a rate of from 4 to 5 inches per hour. If the electric current were too powerful the carbons became unduly heated, and presented additional resistance to the passage of the current; the points at the same time lost their regular conical form. If, on the other hand, the current were too weak, the electric arc played about the points of the carbons in an irregular manner, and the light was easily extinguished by currents of air.

In the course of these experiments I was struck with the apparently insignificant part which the insulating material played in the maintenance of the light between the carbon points; and it occurred to me to try the effect of covering each of the carbons with a thin coating of hydrate of lime, and mounting them parallel to each other in separate holders, and without any insulating material between them. The use of the lime covering was intended to prevent the light from travelling down the contiguous sides of the carbons. On completing the electric circuit the light was maintained between the two points, and the carbons were consumed in the same regular manner as when the insulating material had been placed between them.

Two plain cylindrical rods of carbon three-sixteenths of an inch in diameter, and eight inches long, were now fixed in the holders parallel to each other, and one-eighth of an inch apart. The strength of the alternating current was such that it would fuse an iron wire 0·025 of an inch in diameter and 8 feet in length. On establishing the electric current through the points of the carbons by means of a conducting paste composed of carbon and gum, the light was produced, and the carbons burnt steadily downwards as before.

Four pairs of naked carbons mounted in this manner were next placed in series in the circuit of a four-light machine, and the light was produced from these carbons simultaneously, as when the insulating material was used between them. The light from the naked carbons was also more regular than that from the insulated ones, as the plaster-of-Paris insulation did not always consume at the same rate as the carbons, and thereby obstructed the passage of the current. This was evident from the rosy tinge of the light produced by the volatilisation of the calcium simultaneously with the diminution of the brilliancy of the light from the carbons.

The only function, therefore, which the insulating material performs in the electric candle, as shown by these experiments, is that it conceals the singular and beautiful property of the alternating current to which I have directed attention.

As I have already said, the strength of the alternating current must bear a proper proportion to the diameter of the carbons used, and when a number of such lights are required to be produced in the same circuit, the quantity and property of the current will remain constant, while the tension will require to be increased with the number of lights.

This simple method of burning the carbons will, I believe, greatly further the development of the electric light, as the carbons can be used of much smaller diameter than has hitherto been possible. They may also be of any desired length, for as they are consumed they may be pushed up through the holders without interrupting the light. One of these developments will be a better method of lighting coal and other mines. In this application the alternating currents or waves from a powerful electro-magnetic induction machine may be used for generating, simultaneously, alternating secondary currents or waves in a number of small induction coils, placed in various parts of the mine. The light may be produced in the secondary circuits from pairs of small carbons enclosed in a glass vessel having a small aperture to permit the expansion of the heated air within. Diaphragms of wire gauze may be placed over the aperture to prevent the access of explosive gas. By generating secondary currents or waves without interrupting the continuity of the primary circuit, the contact breaker is dispensed with, and the subdivision of the light may be carried to a very great extent.

CORRESPONDENCE.

HYDROPHOBIA.

To the Editor of the Chemical News.

Sir,—It may interest some of your readers to know that I have discovered an easy, prompt, and very efficient permanent cure for hydrophobia, adapted both to man and animals. I shall be happy to attend to any such cases. Apologising for trespassing on your valuable space,—I am, &c.,

Per Doctor S. G.,
G. R. de Stefano, Avocat.

77 and 78, almerston Buildings,
Old Broad Street, E.C.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—In connection with the valuable paper on water analysis, by Prof. Tidy, of which an abstract appears in your issue of this week, we wish to call attention to the importance of conducting the determination of organic matter with permanganate solution, in darkness or very subdued light. We have found that in the direct rays of the summer sun a weak solution of potassium permanganate, containing free sulphuric acid, is rapidly decomposed, oxygen is given off in bubbles, the solution loses its pink colour, and a brown deposit of a lower oxide or hydrate of manganese occurs. There can, we think, be little doubt that broad daylight, when possessing any active power—not, perhaps, in mid-winter—would have an appreciable influence upon such attenuated solutions as those produced by adding the standard permanganate to water in the usual manner.

The check experiments with distilled water afford no safeguard against this source of error, since they serve for the valuation of the hyposulphite solution, and are evidently assumed to represent the original titre of the

permanganate. The gradual but steady advance in favour of a form of the permanganate process has special interest for one of us, by whom the use of the original method, at that time recently introduced by the late Prof. Miller, was strongly advocated in your columns nearly twelve years ago (Chemical News, vol. xv., p. 47), an advocacy which subjected its author to some rather rough criticism at the hands of an anonymous correspondent in a later number of the journal.—We are, &c.,

A. H. Downes, M.D.,
Thos. P. Blunt, M.A.

Shrewsbury, December 16, 1878.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Chemiker Zeitung.
No. 47, 1878.

The Aschaffenburg Paper Company manufacture coloured papers from cellulose which strongly resemble silk in appearance. The mass is dyed to any desired shade, and the paper when made is printed with any desired pattern by means of the cylinder machine. These papers are used for covering paste-board boxes and packing cases, and for wrapping up articles *de luxe*.

Improved cork-borers, designed by Prof. Reimann, are coming into use in Berlin. The sets are accompanied with an instrument for sharpening the cutting edges.

It is rumoured in Paris that carbon, iron, silver, and gold are compound bodies, capable of dissociation at sufficiently elevated temperatures.

In the Caucasus there is now such an excess of naphtha that the proprietors do not know what to do with it.

The manufacture of fish-manure on the Atlantic coasts of the United States is rapidly extending.

Gold has been found in a mass of meteoric iron of Californian origin.

No. 48, November 28, 1878.

Notes on Porcelain Painting.—V. Joclét.—Violet colours are prepared as follows:—A limpid and as near as possible neutral solution of gold in nitro-hydrochloric acid is first obtained. It is diluted with distilled water, and a solution of freshly-prepared stannous chloride of spec. grav. 1·700 is added, with constant stirring, till the liquid takes a deep red-brown colour; a few drops of concentrated sulphuric are then added to precipitate the suspended matter, which is then washed five or six times with fresh spring water (a very fluctuating article!), and is then, whilst still moist, spread with a spatula upon a plate of glass, upon which there has been previously laid a mixture produced by the fusion of 5 per cent red lead with 2 per cent quartz sand and 1 per cent calcined borax. This intimate mixture of gold-precipitate or lead-glass is slowly dried upon the same plate in a moderately warm room, and then finely ground, still upon the plate. The proportion of the lead-glass to the gold only holds good for a certain degree of heat, at which the colour is burnt in upon the ware, and which is near the melting-point of silver. At a lower temperature, dead, brownish colours are produced. If, however, the proportion of lead-glass is greater, a less degree of heat will suffice. The above-mentioned proportions give a reddish-violet. For a blue violet, 0·5 grm. of the gold preparation is mixed with 10·5 of the lead-glass, and treated as above directed. The lead-glass is made with 4 per cent red lead and 1¼ quartz sand. The colour thus obtained can be used for modifying other blues, but it is unfit for colouring glass.

The rose shades, especially for light grounds upon porcelain, are difficult to prepare and to apply. They can only be laid on very thin, otherwise the gold is apt to separate out in the metallic state, leaving a colourless residue. Dr. Richter gives the following formula for a fine rose shade:—1 grm. gold is dissolved in aqua-regia; at the same time 50 grms. alum are dissolved in 20 litres of spring water, and both liquids are mixed. The whole is then stirred whilst 1·5 grms. stannous chloride at 1·700 sp. gr. are added. The alumina is then precipitated with ammonia, the clear liquid is decanted off, and the precipitate is washed from 7 to 10 times with distilled water, collected on a filter and dried at a gentle heat. The result is mixed with 2·5 grms. carbonate of silver and 70 grms. lead-glass (prepared as for reddish violets) upon a glass plate, dried and rubbed very fine.

Dark purple is prepared like the violets, but a quantity of carbonate of silver is added to the mixture of gold and lead-glass.

For light purples, tin-turnings are dissolved in boiling aqua-regia, and the solution is concentrated in the water-bath. The resulting stannic chloride is then dissolved in a mixture of equal parts of distilled water and stannous chloride, mixed again with water and a clear solution of 0·5 grm. gold in aqua-regia is then added. The whole is then precipitated by the addition of ammonia. If too much of this reagent is used, when a deep red colouration appears, the addition of a few drops of concentrated sulphuric acid is requisite. After washing, the preparation is mixed upon a glass plate with 20 parts of lead-glass, consisting of 3 per cent red lead, 1¼ quartz sand, and 1 per cent anhydrous borax, dried in a moderately warm place, and ground up with 3 grms. carbonate of silver.

Volumetric Determination of Manganese.—Morawski and Stingl base their process on the fact that 4 mols. permanganate oxidise 6 mols. manganous chloride to hydrated peroxide. They convert the manganese into manganous chloride, and titrate with permanganate till a rose colouration sets in.—*Journ. Prakt. Chemie.*

No. 49, December 5, 1878.

The Question of Incremation Historically Treated.—Dr. B. Kneisel.—The author doubts whether the cremation of the dead has, as is commonly asserted, the advantage of destroying the germs or emanations—be that what they may—by which epidemics are propagated.

In an article on free-trade, the writer complains that German chemists and technologists invited to Russia meet with an endurable treatment only till they have revealed all they know. They are then exposed to every kind of intrigue, and are ultimately dismissed.

Prof. E. von Gorup Besanez died suddenly on the 24th ult.

The Government of Zurich has prohibited the use of all colouring matters containing compounds of lead, arsenic, copper, chrome, zinc, antimony, bismuth, and mercury for colouring and decorating esculents, wearing-apparel, packages for chocolate, coffee, tea, chicory, tobacco, &c., toys, covers, and cushions of children's carriages, carpets, curtains, window-blinds, lamp-screens, wafers, or earthenware table services. Poisonous organic matters, *e.g.*, gamboge, picric and picramic acids, and the aniline and phenol colours, are not to be used in colouring confectionery, wines, liqueurs, and syrups.

Platinum black of excellent quality is obtained by boiling a solution of platinic chloride with salt of Seignette. The deposit is washed and dried at a moderately high temperature.

Gold and palladium are precipitated from their neutral solutions in a finely-divided metallic state by a current of pure coal-gas.

Reaction of Strychnin.—Selmi finds that strychnin, moistened with a solution of iodic acid in sulphuric acid, turns yellow, brick-red, and purple. The *Apotheker Zeitung* points out that morphin gives the same colouration with the proposed reagent.

Reimann's Färber Zeitung,
No. 44, 1878.

The "Congress for the Defence of Industrial Property," which met in Paris during the month of September, has for its object to bring about joint action of all goverments as regards patents, designs, and trade-marks. It is announced that Switzerland is about to introduce a system of patent-laws, and will consequently be no longer the refuge of infringers.

No. 45, 1878.

In a long article the editor gives his formal adhesion to the protectionist movement.

No. 46, 1878.

This issue contains a continuation of the editor's dissertation on the benefits of protectionism.

Biedermann's Central-blatt.
October, 1878.

Composition of the Sands and of the Water of some Streams in Vorarlberg.—Dr. W. Engling.—In these waters the proportions of sulphate of lime and of magnesian salts are very considerably smaller in winter than in summer, whilst the quantity of carbonate of lime is much increased.

Obtaining Spaces Free from Oxygen.—Prof. J. W. Gunning.—The author doubts the conclusions of Pasteur that certain low organisms are able to maintain the processes of fermentation and putrefaction in the absence of free oxygen, obtaining their supply of that element from compound organic molecules. He questions if the total absence of oxygen in the receptacles used in experiments has received a satisfactory demonstration.

Soda salt-petre in Holland is very extensively adulterated with kainit.

Heft 11.

Investigation as to the Influence of the Colour of Soils upon their Temperature.—Prof. E. Wollny.—From a long series of experiments, the results of which are here tabulated, the author concludes that during the warm season dark soils are on an average hotter than pale soils, both being air-dried. The daily oscillations of temperature are greater the darker the soil. The difference is greatest at the time of the daily maximum soil temperature, but very small at the time of the minimum. The fall of temperature in the night is therefore more rapid in dark than in pale soils, though the former do not actually reach a lower temperature than in the latter. The differences of temperature between dark and pale soils become smaller as the depth increases, and almost vanish during winter and in cloudy weather. If the proportion of humus, however, exceeds a certain limit the influence of colour may be reduced or altogether annulled.

Excretion of Carbonic Acid through the Skin.—S. Fubini and J. Ronchi.—The quantity of carbonic acid thrown off by the hand and fore-arm in darkness is to the quantity evolved in the light as 100 : 113. The amount given off rises with the temperature, and is greater during digestion than when the stomach is empty.

Plants in their Dependence upon Heat.—Dr. H. Briem.—Plants grow more luxuriantly when their earliest stages of development are accelerated by heat than if they are subject to occasional retardations.

Occurrence of an Amid of Glutamic Acid in the Sprouts of Pumpkins.—Prof. E. Schultze and J. Barbieri.—Not suitable for abstraction.

MISCELLANEOUS.

Letts's Diaries.—Messrs. Letts, Son, and Co. have revised their entire series of Diaries, introducing for the year 1879 several new editions, and discontinuing the publication of the least popular of the old editions. The No. 8, or Office Diary, is a very useful one. Messrs. Letts also publish Saxby's "Weather Table Almanack," which gives information on the average height of tides, height of barometer, list of days on which the weather is likely to change, the principal cyclonic periods of 1879, and much other useful information.

ROYAL INSTITUTION OF GREAT BRITAIN,
ALBEMARLE STREET, PICCADILLY, W.

LECTURE ARRANGEMENTS BEFORE EASTER, 1879.

Lecture Hour, Three o'clock.

CHRISTMAS LECTURES.

Professor DEWAR, M.A., F.R.S.—Six Lectures on A Soap Bubble; on Dec. 28 (Saturday), 31, 1878; Jan. 2, 4, 7, 9, 1879.

BEFORE EASTER, 1879.

Professor EDWARD A. SCHAFER, F.R.S., Fullerian Professor of Physiology, R.I.—Twelve Lectures on Animal Development; on Tuesdays, Jan. 14 to April 1.

J. H. GORDON, Esq.—Four Lectures on Electric Induction; on Thursdays, Jan. 16 to Feb. 6.

Professor TYNDALL, D.C.L., F.R.S., &c.—Eight Lectures on Sound, including its Recent Applications and Methods of Reproduction; on Thursdays, Feb. 13 to April 3.

Professor H. G. SEELEY, F.L.S., F.G.S.—Three Lectures on Reptilian Life; on Saturdays, Jan. 18, 25, Feb. 1.

REGINALD W. MACAN, Esq. (Ch. Ch. Oxford).—Four Lectures on Lessing; on Saturdays, Feb. 8 to March 1.

WALTER H. POLLOCK, Esq., M.A.—Two Lectures on Richelieu and Colbert: on Saturdays, March 8, 15.

F. SEYMOUR HADEN, Esq.—Three Lectures on Etching; on Saturdays, March 22 to April 5.

Professor DEWAR will give a Course of Lectures after Easter.

Subscription to all the Courses in the Season, Two Guineas; to a Single Course, according to length, One Guinea or Half-a-Guinea; to the Christmas Course, Children under Sixteen, Half-a-Guinea.
Tickets now issued daily.

The Friday Evening Meetings will begin on January 17th, at 8 p.m. Professor Tyndall will give a Discourse on the Electric Light, at 9 p.m. Succeeding Discourses will probably be given by Professor W. E. Ayrton, Mr. H. H. Statham, Rev. H. R. Haweis, Professors Johnstone Stoney and Roscoe, Sir William Thomson, Professor Huxley, Mr. E. B. Tylor, Professor Abel, Sir Henry C. Rawlinson, and Dr. Warren De la Rue. To these Meetings Members and their Friends only are admitted.

Persons desirous of becoming Members are requested to apply to the Secretary. When proposed, they are admitted to all the Lectures, to the Friday Evening Meetings, and to the Library and Reading Rooms; and their Families are admitted to the Lectures at a reduced charge. Payment:—First year, Ten Guineas; afterwards, Five Guineas a year; or a composition of Sixty Guineas.

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INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

An Examination in Practical Chemistry in connection with the Institute of Chemistry will be held during the last week of January next. Examiner, Dr. W. J. Russell, F.R.S. Candidates can obtain further information on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London W.C.

THE CHEMICAL NEWS.

Vol. XXXVIII. No. 996.

A REMARKABLE SPECIMEN OF SILICON-IRON.*

By J. LAWRENCE SMITH, Louisville, Ky.

The specimen of iron to which I would call attention has been in my possession for two or three years, but it is only recently that I have given it a very thorough examination. My attention was attracted to it by a jeweller to whom it had been sent to ascertain what it was, coming from a lady living not far from my place of residence (Louisville, Ky.), who had picked it up in the field, and had used it for some time as a weight to keep open the door of one of her rooms. And this is all the history I have been able to obtain of its origin.

Upon receiving it I concluded at once that it was a piece of a *fonte*, having the form of the gutters into which the iron is run from the *haut fournaux*, with the raised borders. Its brilliancy and smooth surface especially attracted my attention, and it was very evident that there was something alloyed with it causing this peculiarity. On subjecting it to chemical examination, to my amazement I found it to resist most every chemical agent except strong fluohydric acid and fused caustic soda or potash at a red-heat (the fused mass being subsequently soluble in the ordinary acid).† The mass is such as is now presented. It is evidently a piece of a much larger mass. Its form is of the character already specified; colour about that of platinum; sp. gr., 6·50; very brittle, being easily broken with the hammer—it is harder than ordinary *fonte*, and somewhat vesicular in structure; fuses at about the temperature of cast-iron, and if heated a little higher in the air burns brilliantly. 1 grm. in coarse powder was subjected to the following treatment:—

25 c.c. of nitric acid was added to it, and evaporated over a water to dryness, then treated with a little acid and water, and in the solution was found only 0·031 peroxide of iron. The undissolved portion, treated with the same quantity of *aqua regia* over a water-bath, evaporated to dryness, and the residue treated with water, gave 0·377 grm. peroxide of iron. The remaining iron, treated with a second portion of nitric acid, yielded only 0·0005 grm.; then treated a second time with *aqua regia*, gave 0·40 peroxide; then with nitric acid and chlorate of potash with a loss of only 0·00025 grm.; and, lastly, with 5·0 grm. of iodine in water with a little iodide of potassium, it showed a loss represented by 0·001 grm. Thus, after all these repeated treatments with reagents whose action is so marked on iron, the 1 grm. left unattacked 0·715 grm.

One grm. was pulverised finely, and fused with 6 grms. of bisulphate of potash, and after the first cooling a little sulphuric acid added, and the mass re-fused: in this instance 0·620 grm. remained unattacked.

A small lump was placed in *bromine* in a stoppered bottle, a portion of it being above the surface. It originally weighed 2·765 grms.; and after *three months' action* it was taken out perfectly bright with an *increase* of 0·002 milligrm. This minute increase was doubtless produced by the bromine penetrating some of the pores; and finding some little iron that it could combine with. The same experiment was repeated with iodine with the same result.

A piece weighing 4·620 grms. was placed in a bottle with pure *chlorine gas*, and a few drops of water on the bottom of it. It was left thus *three months*, and when taken out weighed 4·390, showing a loss of 0·230 grm., equal to about 5 per cent of the original mass. Treated with fluor-hydric acid, it is dissolved, leaving a residue of 0·601 per cent of scaly graphite; the hydrogen evolved had no odour of hydrocarbon, evincing the absence of combined carbon.

Analyses were made of fragments broken from different parts of the original mass. By pulverising the iron finely and adding 2 parts of caustic soda and 2 parts of carbonate of potash, and fusing it on a gold lined crucible at a red heat, the action is vigorous, inflammable gas bursting through the fused matter. After all action ceased the mass was allowed to cool, and treated with hydrochloric acid, which dissolves completely the contents of the crucible, the little graphite having been oxidised by the fused caustic soda. The analysis is then completed in the ordinary way. The result obtained was—

Iron	84·021
Silica	15·102
Scaly graphite	0·601
Manganese	trace
	99·723

The difference in composition between the pieces examined was very slight, the silicon varying only one or two tenths of one per cent. The result of my investigation, then, is that this metallic mass is a silicon iron, remarkably rich in silicon, and evidently the product of a blast-furnace.

As regards its source all I can say is in the immediate vicinity of the place where it was found, there is no *haut fournaux*, but not many miles distant there are, and at about 100 miles distance there is a blast-furnace that has furnished iron to commerce containing as much as 8 per cent of silicon, and had to cease working in consequence, at that time there being no use for iron rich in silicon, such iron, in fact, being considered of an inferior quality; and it is barely possible that at some time this furnace may have produced this iron, although I cannot find any history of it, nor any other piece of the same description of metal.

Although I have enquired of a number of workers in iron I have not learnt that any of them has encountered a similar product from the furnaces. I have, however, more recently seen in a collection of meteoric irons a similar mass about the same weight. It is in the collection of Prof. Shepard, at Amherst, and came from the N.W. portion of North Carolina; not being able to account for its origin he attributed it to a meteoric source. As soon as I had completed my examination of the iron just described, I referred to description of the silicon meteoric iron described by Prof. Shepard,* and at once recognised a parallel to mine, but was more confirmed in this opinion when I subjected some fragments he sent me to the test already described, finding, however, that the silicon in this latter iron run up to 17 per cent, being much higher than it had been made out by Prof. Shepard, or M. Wöhler, who also examined it at the time of its discovery. It resists, in the same way, the action of the strong acids, and of chlorine, iodine, and bromine. From the above examination I expected to find the mass in all respects to be like mine, which was the case when I did see it some months after the examination; its structure being only a little less vesicular, its shape was the same, being that of a fragment of the rough *fonte* from the *haut fournaux*, having two fractured surfaces on the end.

The accidental discovery of these masses of silicon-iron is not without an important significance. For it demonstrates that iron can be produced on a large scale with a percentage of silicon that is very much greater than has been made even in laboratory operations, and fully twice the amount contained in the silicon-ferro-manganese of *Terre-noire*.

If the manganese in any way interferes with the introduction of a larger portion of silicon, it might be prefer-

* Presented to the Academié des Sciences, December 8, 1878.

† Chlorhydric acid attacks the iron slightly, with the evolution of a little gas.

* *Am. Journ. Science*, xxviii., 1859, p. 259.

able to omit the manganese and enrich the iron with silicon. The two alloys (ferro-manganese and silicon-iron) could be then introduced separately in the proper proportion into the melted iron, for the value of silicon during the converting process cannot be too highly appreciated. If at the same time a ferric aluminium alloy could be introduced, we should have a valuable element for the elimination of phosphorus, for the sesquioxide of aluminum once combined with phosphoric acid resists very persistently subsequent decomposition, and in this way the phosphorus would escape with the slag.

A specimen of the above silicon-iron was submitted, at the *Ecole Normale*, to the action of the oxy-hydrocarbon blowpipe. It acted exactly like specimens of silicon-iron, made in that laboratory and experimented with by MM. Troost and Hautefeuille, which iron contained 15 per cent of silicon; when melted on a piece of lime it presented the same appearance as the button of silver in a cupel, there being not the slightest scintillation. A piece of ordinary cast-iron heated along side of this with the same flame melted, and then burnt with the most brilliant scintillation. The largest amount of silicon that was present in richest specimens of iron alloys at the recent French exposition was 10 per cent.

NOTE ON THE DETERMINATION OF SPECIFIC GRAVITIES.

By WILLIAM A. TILDEN.

BEING desirous of comparing some results of my own with others that have been published, my attention has been drawn very peremptorily to the inconvenience arising from a want of agreement among chemists as to the meaning of the terms specific gravity, boiling-point, and the like. The entire absence of uniformity in regard to these matters combined with the practice, which seems to be on the increase, of omitting experimental details in the statement of results renders a large amount of otherwise important work entirely valueless. An example or two will make clear my meaning, my remarks applying chiefly to the specific gravities of liquids.

The following appears in a paper by P. and A. Saytzeff in *Liebig's Annalen*, Bd. 193, 363 :—

"Weight of water at 0° = 1·0015 grm. Weight of diallyl-propyl-carbinol at 0° = 0·8730; at 20° = 0·8577. Specific gravity of diallyl-propyl-carbinol at 0° = 0·8707; at 20° = 0·8564, compared with water at 0°."

The term specific gravity is here used in a sense which is commonly understood, but which is nevertheless inaccurate. For the term specific gravity, if it means anything, must be defined as the ratio of the mass of a given substance to that of *an equal volume* of water or some other standard, taken not necessarily at the same temperature but at least at some temperature universally agreed upon. The number 0·8564, given as the specific gravity at 20°, is not the specific gravity, because equal volumes of the liquid and the water were not compared. Doubtless they were weighed in the same vessel, but the water was weighed only at 0°, whilst the liquid was weighed at 20°, and no account is taken of the expansion of the vessel or of the difference of density of water at 0° and 20°. Making allowance for the difference in the capacity of the vessel, the specific gravity referred to water at 0° would be 0·8551 approximately) instead of 0·8564. In the present case the authors show how the number 0·8564 was arrived at, and no great harm is done. Nevertheless this number will be abstracted into chemical literature as representing the specific gravity.

Again F. V. Spitzer (*Deut. Chem. Ges. Ber.*, xi,. 1815) gives the specific gravity of a camphene at 99·84° C. as 0·8345. This is the bare statement, and as it stands it has no meaning. It might have been arrived at by either of the following methods :—

a. By weighing both the camphene and the water at the same temperature.

b. By weighing the vessel full of camphene at 99·84°, whilst the same vessel full of water was weighed at some other temperature, as 0°, 4°, or 15°.

c. By weighing the camphene at 99·84°, ascertaining the weight of water which at 4° fills the vessel, and then calculating the increased capacity of the vessel at 99·84°, and hence the weight of that volume of water assumed to be still at maximum density.

d. Or by some other method, not depending upon the filling of a bottle or tube.

Each of these would lead to a different result.

Without information as to which method was adopted the number given for this specific gravity is useless as a character of the substance.

If we adopt strictly the definition of specific gravity already given, the ratio of the weight of a given mass to that of an equal volume of water at 4° taken as unit, or as the quotient obtained by dividing the weight of a given mass by the weight of an equal volume of water at 4°, the necessary calculations become somewhat formidable.*

It would be useless to expect chemists generally to undertake such labour, and in ordinary cases very little would be gained by it, because the experimental errors would be greater than the corrections. On the other hand, so long as these corrections are ignored, the numbers, including six, five, or even four places of decimals, which are frequently set down with a pretence at extreme accuracy, are to be deprecated as misleading.

To get rid of the anomalies to which I have referred would be easy enough, if in publishing results chemists would in all cases mention the experimental data from which the specific gravity is to be calculated, or at least the method of calculation. And a great deal of trouble in the way of re-calculation would be saved if some uniform procedure were generally adopted. At the present time the very common practice in determining the specific gravity of a liquid is to weigh the liquid and the water successively in the same vessel at the same temperature. This plan recommends itself on the score of simplicity; but it has one disadvantage, viz., that if the specific gravity has been determined at two or more temperatures, the numbers so obtained are not available without correction for the calculation of the co-efficient of expansion of the liquid.

I prefer to proceed thus: Fill the specific gravity bottle or tube with water, carefully adjusting the temperature to 4°; weigh with proper precautions, and record the result once for all. This gives not only the weight of the water at 4°, but the capacity of the vessel in cubic centimetres. From this the capacity at any other temperature can be calculated by the well-known formula—

$$V = v(1 + kt.)$$

The co-efficient of expansion of glass, k, may be taken as 0·000026; t is the difference of temperature from 4° c.

A table of values can thus be drawn up and kept with the specific gravity bottle. Now, suppose a specific gravity has to be determined at 25°. Fill the vessel at this temperature and weigh. Look to the table and find the capacity of the vessel at 25°. The number of c.c. there recorded represents the number of grms. of water at 4° which would be equal in bulk to the weighed quantity of liquid taken at 25°. Then divide the weight of the liquid by the weight of this quantity of water.

A partial avoidance of the error arising from weighing in air may be accomplished by employing a glass vessel of nearly the same shape and capacity as counterpoise for the vessel in which the liquid is weighed, in place of the usual metallic counterpoise. This has the advantage not only of displacing the same volume of air, but of condensing and retaining the same amount of atmospheric

* Compare Matthiessen and Hockin, "Laboratory," p. 189.

gases, and so altering in weight at different times to the same extent as the specific gravity bottle.

Another consideration here suggests itself. The so-called empty bottle is really weighed full of air,; is it worth while to take this into account? In general, the advantage to be gained is very small, for the density of normal air being only about 0·00129 as compared with water at the same temperature, this correction affects only the fourth figure in the quotient. When this degree of accuracy is required the operator ought not to stop here, but reduce all his apparent weights to their true equivalent *in vacuo*.

Lastly, I may mention that except for rough purposes I have discarded all specific gravity *bottles* as being completely unmanageable. I have found great advantages in the use of the tube described by Dr. Sprengel a few years ago (*Journ. Chem. Soc.*, [2] xi., 577).

ON THE PURIFICATION OF CAST-IRON FROM PHOSPHORUS.

By SERGIUS KERN, M.E., St. Petersburg.

MANY readers of this journal certainly remember the able and well illustrated article of Mr. J. E. Stead, "Phosphorus in Cleveland Iron-stone and Iron" (CHEMICAL NEWS, vol. xxxviii., pp. 14, 39, and 43). The experiments on the elimination of phosphorus in cast-iron by Mr. Edward Williams, mentioned in this article, were so interesting that they were repeated by the author of this paper, and gave very good results. It will be seen that various pig-irons were used. The process of Mr. Williams is based on the following operation:—

Fluid pig-iron is poured into a crucible containing mill-scale in a fluid state with an addition of pure sand. The quantity of sand used is about 20 per cent. Next, the contents of the crucible are violently shaken for about a quarter of a minute, and after this operation the refined metal is poured into moulds. The sand used during these experiments had the following composition:—

Silica	87·90 per cent.
Lime	2·52 ,,
Alumina, Ferric oxide	4·38 ,,
Phosphorus	none ,,
Sulphur	trace ,,
Moisture..	5·20 ,,

The scale during the process used had the following average composition:—

Protoxide of iron	73·22 per cent.
Peroxide of iron	12·98 ,,
Silica	10·13 ,,
Phosphorus	none ,,
Sulphur	0·02 ,,
Protoxide of manganese	0·48 ,,
Lime, Magnesia, Alumina	3·07 ,,

The following table shows distinctly the value of this process for the elimination of phosphorus in cast-irons:—

Nos. of Samples of Cast-irons.	Per cent of Phosphorus.	
	In Cast-Iron.	In Refined Metal.
1.	0·94	0·052
2.	1·03	0·047
3.	0·54	0·028
4.	0·67	0·031
5.	0·43	0·013
6.	0·12	0·010
7.	0·75	0·049
8.	0·68	0·032
9.	1·25	0·050
10.	1·05	0·047

The author remarked that in this process much depends upon the temperature of the cast-iron, and the overheating of the metal spoils all the work.

A NEW TEST FOR ARSENIC.

By OTIS JOHNSON.

PLACE the mixture containing arsenious or arsenic compounds in a Marsh apparatus with a concentrated solution of potassic hydrate and a little aluminum wire. Upon warming, AsH_3 will be evolved, which may be subjected to the usual tests. If, however, the gas blackens argentic nitrate the proof is quite conclusive, since antimony by this process is not converted into SbH_3. The equations are:—

$$3H_3AsO_3+6Al+18KHO=3AsH_3+3Al_2(OK)_6+9H_2O.$$
$$3H_3AsO_4+8Al+24KHO=3AsH_3+4Al_2(OK)_6+12H_2O.$$

University of Michigan,
November 30, 1878.

ON THE METHOD OF EXTRACTING GOLD, SILVER, AND OTHER METALS FROM PYRITES.*

By W. A. DIXON, F.C.S., Cor. Mem. Nat. Hist. Soc. Glasgow.

(Continued from p. 294).

As the formation of sulphate of copper during the calcination of pyrites is believed to take place in two stages, represented by the equations—

$$CuS + 3O = CuO. + SO_2, \text{ and}$$
$$3CuO + SO_2 = CuSO_4 + Cu_2O.,$$

I tried whether the addition of successive portions of raw ore would not gradually convert the greater part of the copper into sulphate during the roasting. After well roasting a quantity of pyrites, I extracted the sulphate formed with water from a sample; this was then dried, and the copper present as oxide was dissolved by dilute hydrochloric acid, and its amount determined. It was found to be equal to 6·54 per cent of copper.

To 700 grains of the remainder (from which the sulphate had not been extracted), I added 40 grs. of fresh pyrites and roasted sweet at a dull red heat in a small muffle, which took about an hour, treated a portion as before, and found the copper present as oxide to be 6·01 per cent. The remainder was again made up to 700 grs. with once-roasted ore, 40 grs. raw pyrites added and roasted sweet, when other 40 grs. was added and the calcination continued until complete, when the copper present as oxide was found to be 4·79 per cent. The oxide was thus steadily reduced, but the process was evidently too slow to be of use practically.

I then calcined 400 grs. of pyrites, mixed the residue with 200 grs. of raw ore and again calcined, then added 100 grs. of raw ore, and continued the operation until fumes were no longer evolved, when the residue was found to contain 6·46 per cent of copper as oxide. This process was therefore of no value; but I noticed that after each addition of pyrites considerable quantities of white vapours were evolved, and as the ore contained but little arsenic this could only arise from the formation of sulphuric anhydride. I therefore proceeded to determine how much sulphuric acid could be obtained by calcining a mixture of raw pyrites and roasted residue.

A combustion-tube was fitted with a smaller tube leading through water in a Woolfe's bottle, the second neck of which was connected with an aspirator, and mixtures of raw and roasted pyrites were heated to a dull-red in

* Read before the Royal Society of N.S.W., August 1, 1877.

the combustion-tube, a current of air being maintained through the whole apparatus, and the ore occasionally stirred with a bent wire. In this arrangement, however, I found that a large quantity of the white fumes escaped condensation, and I therefore substituted for the Woolfe's bottle a flask containing a small quantity of water, the exit tube of which was connected with an inverted Liebig's condenser. The water in the flask was kept gently boiling, and I found that by this arrangement the condensation was very good. 100 grs. of raw pyrites containing 37·86 per cent of sulphur, mixed with 50 grs. of the same which had been well roasted and the copper extracted, was thus treated. The residue in the tube was digested with hydrochloric acid, and the sulphuric acid formed determined in one-half of the solution, whilst in the condensed water sulphuric acid was determined in one-fourth:—

¼ of residue gave barium sulphate .. .. .. 31·65 grs.
¼ of condensed water gave barium sulphate .. 35·82 „

Calculated on the 100 grs. used, this gave—

Sulphuric acid in residue = 8·68 sulphur.
„ „ water = 19·86 „

Total .. 28·54 sulphur.

Similarly, 100 grs., with 20 grs. residue gave—

¼ residue, barium sulphate .. .. 31·69 grs.
¼ water „ „ „ .. .. 34·59 „

Which calculated on 100 grs. used gave—

Sulphuric acid in residue = 8·70 sulphur.
„ „ water = 19·0 „

Total .. 27·70 sulphur.

On reducing the roasted ore to 15 grs., a smaller return was obtained; but these results showed that by proper management nearly three-fourths of the sulphur present in the ore could be obtained as sulphuric acid, either in the free state or in combination with copper and iron—this quantity is nearly sufficient to dissolve both the copper and iron, the latter as ferrous sulphate, the theoretical quantity required with the ore operated on being 29·67 per cent of the sulphur converted into sulphuric acid—and opened at once a prospect of the attainment of the desired result.

As it was probable that such a result would not be attained on a large scale, I proceeded to examine the action of aqueous sulphurous acid, and found that by treating ore calcined at a low temperature therewith, a considerable quantity of sulphate of iron was obtained in solution along with the sulphate of copper; also that, as Muspratt had observed, aqueous sulphurous acid readily attacks finely divided metallic iron, forming sulphite and hyposulphite.

The form the process now presented itself in was to calcine the ore at a low temperature and extract the sulphates of copper and iron formed with the mixed sulphurous and sulphuric acids formed during the roasting, then to reduce all the iron to the metallic state and remove it in the same manner, when the gold, silver, antimony, and lead would be left. The only points that remained to be decided were, how to reduce the iron to the metallic state and to obtain the copper from solution.

The reduction of the iron was necessary, because the sulphuric acid obtained would be too dilute to act on the ferric oxide, and the quantity would be insufficient to form ferric sulphate, whilst sulphurous acid has no action on the ferric oxide. I first attempted the reduction of the iron by hydrogen at a faint red heat, which gave the metal in a form very suitable for the action of sulphurous acid. This had to be abandoned, however, on account of the cost and the danger of explosion. Coal-gas reduced the iron readily, but at a low temperature much finely divided carbon was deposited amongst the iron, which rendered wetting it difficult, and the powder was very pyrophoric. Reduction by finely ground carbon at a low red heat, I found could be so managed as to obtain the iron as a metallic powder which was readily attacked.

For the removal of the copper from solution the use of metallic iron had to be abandoned, on account of the quantity required to precipitate it from its solution as sulphate, which on the large scale is found to be about three times the quantity of the copper precipitated. As it would be advantageous to recover some of the sulphuric acid, the use of sulphuretted hydrogen presented itself, but after repeated trials the exceeding bulk of the precipitate presented an obstacle which on any considerable scale would be insuperable, and has indeed been found to be so where tried.

I therefore determined to try whether it could not be recovered by crystallisation; and the result of many trials showed that by taking a cold saturated solution of sulphate of copper, and, after adding sulphuric acid, saturating it with sulphurous acid, I had a solution which would render all but traces of the copper and sulphate of iron in well-roasted pyrites soluble without dissolving any. In fact it deposited crystals on being mixed with the calcined ore from the sulphates of copper and iron withdrawing crystallisation water. By then washing by displacement with a solution of sulphate of copper saturated in the cold made boiling hot as long as the escaping solution deposited crystals on cooling, the residue was obtained saturated with a solution of sulphate of copper which would not deposit crystals. This solution could be so displaced by water equal to one-half the bulk of the residue as to leave only 0·67 per cent of copper in a soluble form, whilst if an equal bulk of water was used the copper left was only 0·12 per cent. Practically, therefore, it was possible to remove all the copper in such a way as to deposit it in crystals without increasing the bulk of the fluid, so that no evaporation would be required.

The mixed crystals of sulphate of copper and sulphate of iron evolve on calcination large quantities of sulphurous and sulphuric anhydrides, which could be condensed in a solution of sulphate of copper and used to extract a future lot.

I now proceeded to treat twelve pounds of the dressed pyrites of which an analysis is given above. One-half pound at a time was calcined in a muffle having the draft-holes closed with clay, and an iron door fitted at the front. From the back of the muffle an iron pipe led into a small upright leaden tower fitted with movable perforated leaden trays, so that the evolved gases passing over the trays in succession finally escaped to the chimney at the top. On the upper tray water was allowed to drop through a trapped tube, and dripping from tray to tray flowed off through a pipe at the bottom, whilst steam was admitted at the bottom in sufficient quantity to keep the lower half of the tower warm. Half a pound having been calcined, the copper and sulphate of iron was extracted with water containing sulphuric and sulphurous acids, the residue was reduced with carbon at a dull red heat, and the metallic powder being spread on the trays was subjected to the action of the gases from the second half-pound, the residue from which was treated as before, and to the gases from the third and so on, until the whole was operated on. The last half-pound was, after reduction, treated with dilute sulphuric acid, my parcel of ore being exhausted. The whole of the soluble matter was then extracted with water, which reduced it to a small bulk which was almost entirely free from iron, but contained a small quantity of copper as sulphide. It was therefore calcined on an iron tray, and the copper extracted by dilute sulphuric acid. The dried residue weighed 21¼ ozs., and being melted with some oxide of iron and a little carbonate of sodium and carbon gave a brittle button weighing 5¼ ozs. To remove the antimony, as being the most convenient for laboratory use, this button was fused with carbonate of sodium and nitrate of potassium, which left a button weighing 3¼ ozs., which was cupelled to ob-

tain the gold and silver. These were parted with nitric acid; the finely-divided gold, folded up in lead foil, was again cupelled, giving a button weighing 37·54 grs. The silver was precipitated as chloride, to which was added a small quantity precipitated from the copper solution, and on fusion with carbonate of sodium gave a button weighing 158·65 grs. The first cupel button was ground up and fused with sodium carbonate and charcoal, when it gave a button of lead weighing 2 ozs.

The mother-liquors from the sulphate of copper crystals were evaporated to dryness (this evaporation was necessary in the experiment, to recover all the copper, but would be unnecessary on the large scale, the mothers being then used again and again indefinitely so long as there was fresh material to be extracted), and the whole of the sulphate was dried. One-half was heated to a full-red heat, to reduce the sulphates to oxides; the other half was heated to a dull red to decompose the sulphate of iron, then mixed with carbon and a little sand and heated to fusion, when the oxides were added and metallic copper obtained, which with a prill obtained on re-fusing the slags weighed 31¼ ozs.

With the exception of using extraneous sulphuric and sulphurous acids for the extraction of the copper and sulphate of iron formed during the calcination, the whole process was carried out as nearly as practicable in a laboratory as it would be on a large scale. There are good working methods for smelting out the lead and antimony with the gold and silver, and for separating these metals, which I need not detail. The large quantity of sulphate of iron extracted from the roasted pyrites by the use of sulphurous acid would give on calcination more than enough sulphuric acid to extract the oxide of copper formed. The average quantity of sulphate of iron obtained from this ore was about one-half the weight of the sulphate of copper produced.

To conclude, the yields obtained from 12 lbs., as compared with those shown by analysis and assay, were—

	Analysis.	Yield.
Copper ..	17·02 per cent.	16·5 per cent.
Lead	2·01 ,,	1·04 ,,
Antimony ..	3·9 ,,	Not recovered.
Silver ..	62 ozs. 9 dwts. 18 grs.	61 ozs. 13 dwts. 22·7 grs.
Gold ..	12 ozs. 10 dwts. 0 grs.	14 ozs. 11 dwts. 23·2 grs.

These numbers are very satisfactory; and, although it is scarcely to be expected that the results would be equally satisfactory working on a large scale, it seems more than probable that returns better than those by any other process would be obtained.

Whilst experimenting on the removal of copper from solution, I found that this could be conveniently done by filtering the slightly acid solution by ground matt obtained from the same ore by simple melting. This method of separating copper from solution may be of advantage in treating poor copper ores or pyrites containing small quantities of copper; but it is obvious that for ores in which gold and silver form an important constituent, it is not so advantageous as the process already described—as, first, the gold and silver, so far as contained in the matt used for precipitating the copper, would remain with that metal, and be lost; secondly, the sulphuric and sulphurous acids, which in the process above described are obtained by calcination of the sulphates of copper and iron, and are available for the extraction of roasted ore, giving with those evolved during the roasting a superabundant supply of acid, would be lost. Neither of these objections would, however, have any force if copper were the only metal to be extracted. The matt obtained by simply melting poor cupreous pyrites, with the addition of sufficient roasted ore to form a flux for the silica present, consists of sulphide of iron containing more or less sulphide of copper; and by filtering through a bed of this matt the solution of sulphate of copper obtained by calcining and extracting a large portion of the ore, the copper is deposited, whilst the iron goes into solution. I expected to find that the whole of the iron could be thus removed from the matt which would be converted into sulphide of copper, but found that in all cases the action stopped short of this. The percentage of copper in the treated matt varied from 30 per cent to 33 per cent, approaching therefore to copper pyrites, which contains 34·6 per cent of copper. From this residue refined copper could be made in three operations.

This method of treatment, as well as the one above described, for the separation of the various metals, have in common with ordinary copper smelting the advantage that no materials except those yielded by the ore are required, with the exception of fuel, water, and air.

In working ores on the large scale for the recovery of gold and silver by the process, which I have founded on the experiments, of which I have given a brief *résumé*, it is advisable to obtain the sulphides as free as possible from vein stuff before proceeding to the actual treatment. To this end the crushed ore may be washed when any free gold contained in the quartz may be recovered by amalgamation, or in particular cases the ore may be subjected to a preliminary smelting. The method of getting rid of the quartz must depend entirely on the price of labour, fuel, &c., and the composition of the ore. I have found, on the one hand, that nearly all the gold and silver are obtained in a matt if it amounts to from one-half to two-thirds of the original ore, whilst if the matt is smaller both gold and silver are left to a considerable extent in the slags; but there are few ores which would give such a proportion of matt without preliminary dressing. On the other hand, ores containing sulphide of silver lose much of that metal by washing; the sulphide being exceedingly friable, it is carried away in the slimes, which are often richer in silver than the original ore.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 19, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed, the following certificates were read for the first time:—E. H. Rennie, A. J. G. Lowe, P. P. Bedson, C. F. Cross, C. W. Smith, and A. E. Menke.

The PRESIDENT then called on Mr. FRANCIS JONES to demonstrate some points in connection with the preparation and properties of hydride of boron. Mr. Jones read a paper on this subject at the meeting held on Nov. 21, and an abstract of the paper will be found in our report of that meeting.

The experiments shown by the author consisted of the preparation of some magnesium boride by heating a mixture of magnesium dust and boron trioxide. Some magnesium boride was then treated with hydrochloric acid; the gas which came off burned with a vivid green flame. The flame of a Bunsen burner held above the burning jet was also coloured green. On heating the glass tube through which the gas passed to redness the green colour of the flame disappeared.

Dr. FRANKLAND asked the author if he had endeavoured to purify the gas from the hydrogen which it doubtless contained by absorption with ammonia, &c.

Mr. JONES, in reply, said that from preliminary experiments with the silver compound he thought that there was but little hydrogen present; he was endeavouring to obtain the gas in a perfectly pure state.

Dr. FRANKLAND then took the Chair whilst the PRESIDENT communicated a paper entitled "*Researches on the*

Action of the Copper-Zinc Couple on Organic Bodies (Part IX., Preparation of Zinc Methyl)," by Dr. Gladstone, F.R.S., and Mr. Tribe. The authors, from theoretical considerations, came to the conclusion that methylic iodide would be slowly acted upon by the copper-zinc couple at ordinary temperature. A number of dry couples prepared from half a metre of zinc-foil (as described in the *Chem. Soc. Journ.*) were placed in small flasks containing 5 c.c. of methyl iodide. The flasks were then well corked, and examined from time to time. The liquid became gradually somewhat yellow and diminished in quantity. Crystalline plates began to appear in about thirty days, until the whole appeared in from thirty to forty days as a uniform crystalline mass. On removing the corks a slight outrush of gas took place. In two instances out of thirty the flasks burst. This the authors attribute to the accidental presence of moisture, but suggest the use of a mercury valve in the cork. The crystalline mass consisted of zinc methiodide, the analogue of Frankland's zinc ethiodide. On distillation, after filling the apparatus with dry hydrogen at 60°, a clear colourless liquid began to come over: in fifteen minutes the distillate ceased. On examination it presented all the properties ascribed by Frankland to zinc methyl. The residue in the flask consisted of zinc iodide. The authors find that both at the ordinary temperature and at the boiling-point the formation of zinc methyl takes place in a rapidly diminishing ratio with regard to time. On doubling the quantity of the zinc-copper couple present, the time required to decompose a given quantity of iodide is twelve times less, and and by trebling it thirty-six times less. So that 5 c.c. of methyl iodide can be completely decomposed in one day by trebling the zinc-foil used. By further experiments the authors prove that zinc methiodide is alone formed, and that the methiodide splits up very readily by heat without fusing into zinc iodide and zinc methyl. The methiodide is also decomposed by light. Zinc-foil alone has no action at ordinary temperatures on methyl-iodide. The authors conclude by pointing out the additional proof afforded by these experiments as to the value of the copper-zinc couple in bringing about a chemical change at low temperatures, which can only be brought about by its more positive element at such a temperature and under such conditions as occasion the formation of secondary products. It has also given a perfect and simple method of preparing Frankland's most valuable reagent, zinc-methyl; for in two experiments, the details of which are given, 91·7 and 99·2 per cent of the possible quantities were respectively obtained.

Dr. Frankland said that organic chemists would receive this new method with gratitude. He had already pointed out that large quantities of zinc methyl could not be prepared by substituting copper or iron digesters for the glass tube employed on the small scale, whilst recourse to the dangerous and poisonous mercuric methide was to be avoided if possible. The present plan placed this valuable reagent in the hands of chemists. The yield (99·2 and 91·7 per cent) was exceedingly encouraging. He would like to ask if the method had been tried on the large scale, with half a pound of methylic iodide. He had found that with large quantities of ethylic iodide the yield was not so good as on the small scale.

Dr. Gladstone had not tried the reaction with more than 15 c.c. at a time, but saw no reason why the reaction should not succeed on the large scale.

Mr. Tribe said that the materials should be perfectly dry. He had operated with 115 grms. of the ethylic iodide, and obtained a yield of 88·2 per cent of zinc ethyl.

Dr. Gladstone then took the Chair, and called on Dr. Debus to make some remarks on the formula of glyoxylic acid.

Dr. Debus commenced by giving a historical sketch of this substance. In 1856 he obtained it amongst the products of the oxidation of alcohol by nitric acid. He gave it the formula $C_2H_4O_4$. Afterwards, for various reasons, he considered this formula to be erroneous, and he altered it to $C_2H_2O_3(+H_2O)$. The potassium and sodium salts contain 1 molecule of water, but the ammonium salt is anhydrous. Perkin obtained this acid by boiling silver dibromacetate with water; and in various papers, but specially in one (*Chem. Soc. Journ.*, 1877, II., 96), considers the correct formula to be $C_2H_4O_4$, and not $C_2H_2O_3$. The ammonium salt, says Perkin, is decomposed by evaporation *in vacuo* into amido-glyoxylic acid and water. This he proves by testing the reaction of the solution of the ammonium salt before and after condensation. Before evaporation it is neutral, after it is distinctly acid, and therefore the salt is decomposed during the evaporation. To this argument Dr. Debus objects. Ammonium oxalate, when evaporated *in vacuo* over sulphuric acid, becomes acid, though perfectly neutral to test-paper before. Again, dilute sulphuric acid, 1 in 40,000, does not give an acid reaction to litmus-paper by daylight (by gaslight the blue turned most distinctly), but if concentrated by evaporation it gives an acid reaction. So that the reaction of a substance in solution depends on the strength of that solution, and (as litmus-paper varies in delicacy) on the litmus-paper. Perkin's observation, therefore, that ammonium glyoxylate solution was neutral before, but acid after evaporation proves nothing. The author has prepared glyoxylate of ammonium, made a solution, tested its reaction, evaporated it, made it up again to the same strength, and found it not to be more acid than at first. Perkin's conclusions as to the decomposition of this ammonium salt rest, therefore, on a sheet of litmus-paper. On the other hand, this ammonium salt is as much an ammonium salt as ammonium chloride. It gives off ammonia by treating it with cold caustic potash. A precipitate is obtained with platinum chloride, &c. Moreover, the body has all the properties of an aldehyd. In conclusion the author stated the arguments derived from the analogy of the substance to aldehyd, and its place in the series of oxidised products, ending in oxalic acid, as the ordinary aldehyd series ends with acetic acid. In a paper he was about to publish he would go still further into the subject.

Dr. Frankland said that Dr. Debus had given a very learned and interesting exposition of the subject, but he ventured to think that the whole point of the question was whether two semi-molecules of hydroxyl could be united to one carbon atom or not. It had struck him that against the solid facts—obtained by Perkin from elaborate quantitative experiments, and from which he came to the conclusion that the formula of glyoxylic acid was $C_2H_4O_4$—Dr. Debus had offered nothing but surmises. Dr. Debus had dwelt much on the ammonium salt and the loss of water on evaporation, but in his opinion this was quite beside the question; and apart from the theory that two semi-molecules of hydroxyl could not be united to the same carbon atom, no chemist could come to any other conclusion than that arrived at by Perkin.

Dr. Armstrong apologised for the unavoidable absence of Mr. Perkin. He agreed with Dr. Frankland that the ammonium salt had nothing to do with the point at issue. He thought, too, that there was no force in the argument from analogy of the oxidation products because one term in the reaction was missed out.

Dr. Debus, in reply, denied that the theory above referred to by Dr. Frankland had influenced him in changing the formula, and still thought that the question as to whether the ammonium salt was really an ammonium salt or not was of great importance in deciding the true formula of the acid.

The President then called on Mr. T. Wills to give a short communication "*On the Production of Oxides of Nitrogen by the Electric Arc in Air.*"

In the discussion which followed the reading of a paper by L. T. Wright on November 7, Dr. Frankland remarked that it was most important to ascertain whether at the enormously high temperature of the electric arc an oxidation of nitrogen did or did not take place. The author has made experiments to investigate the subject.

Sixty Grove cells were used; they were placed in another room quite removed from the place in which the experiments were made. The carbon points were placed under an inverted funnel, and the air aspirated through dilute potash; the nitrates, &c., were converted into ammonia with aluminium, &c.; the experiment lasted twenty minutes. N_2O_5 was formed equal to 0·54 grm. per hour. A second experiment gave 0·55 grm. A second set of experiments with more efficient aspiration gave 0·6 and 0·7 grm.

Dr. GLADSTONE observed that the amount of nitric acid formed was very considerable; it was a most important observation, especially at the preeent time.

Dr. FRANKLAND said that the results had surprised him, especially as he had used the electric light for twenty years by the hour together without observing any corrosion of the brass or delicate clockwork of the lantern; it would be a very serious matter if anything like this quantity of nitric acid was produced, under all circumstances, by the electric light.

Mr. WILLS, in reply, intimated that he was about to continue his experiments, using a Siemens magneto-electrical machine.

The next paper was read by Prof. W. FOSTER "*On the Action of Alkaline Hypobromite on Oxamide, Urea, and Potassium Ferrocyanide (Part* II.). When alkaline hypobromite acts on oxamide 75 per cent of the nitrogen is evolved; the suppressed nitrogen remains behind as cyanate—

$$4(NH_2)_2C_2O_2+15NaBrO+18NaHO=$$
$$=3N_2+2NaCNO+8Na_2CO_3+15NaBr+17H_2O.$$

By quantitative experiments the N evolved, after neutralising with hydrochloric acid in the presence of sodium sulphite, &c., and again treating with alkaline hypobromite, amounted to 7·73 per cent and 7·84 per cent. A similar reaction takes place between urea and hypobromite; 92 per cent of the nitrogen is evolved, and the rest suppressed as cyanate. By quantitative experiments the author obtained 7·5 per cent of the suppressed nitrogen as the amount existing in the urea residue as cyanate. When hypobromite is boiled with potassium ferrocyanide solution a deep red liquid is obtained capable of evolving oxygen. The author states that it has the appearance and leading properties of sodium ferrate. About one-third of the total nitrogen of ferrocyanide is evolved as gas, the remaining portion being oxidised to cyanate. Cyanides also under similar conditions are converted into cyanates. The author has also investigated the action of hypobromite on acetamide and benzamide; he also intends to observe its behaviour with cyanamide if he can obtain some of the latter substance.

The next paper was read by Dr. LETTS "*On Two New Hydrocarbons Obtained by the Action of Sodium on Turpentine Hydrochloride.*" The author gave some account of his research at the meeting of the British Association, 1876. The action of sodium on solid turpentine hydrochloride fused in a flask is violent: on distilling a white solid substance passes over, followed at a much higher temperature by an oily liquid. The solid substance boils at 157° to 158°. 86 grms. of hydrochloride gave 38 grms. solid and 14·5 grms. liquid. To this solid hydrocarbon, after many analyses, purifications, determinations of the hydrogen evolved during the reaction of the sodium on the hydrochloride, vapour density determinations, &c., the author assigns the formula $C_{10}H_{17}$. It fuses at 94°. It distils at a constant temperature under diminished pressure. The molecular weight determined from vapour density determinations is 136·4 to 137·0. The body by the action of chlorine gives rise to various substances. Bodies with the formulæ $C_{10}H_{17}Cl$ and $C_{10}H_{16}Cl_2$ were obtained. Br has a similar action; but the body $C_{10}H_{17}.Br$ was not isolated. To check his results the author analysed australen and camphen. He concludes that the formula $C_{10}H_{17}$ is correct, and gives the name turpenyl to the new body. The liquid portion of the distillate boils at about 321° C. It has the formula of diturpenyl, $C_{20}H_{34}$. The author has also investigated the action of sodium on liquid hydrochloride of turpentine. Solid turpenyl was obtained, and a liquid boiling at 156° having a similar composition.

Dr. ARMSTRONG suggested that the action of sulphuric acid should be tried, for a mixture of hydrocarbons, $C_{10}H_{16}$ and $C_{10}H_{18}$, might crystallise from alcohol unaltered and distil at a constant temperature under diminished pressure.

In consequence of the lateness of the hour the two following papers were taken as read, and the Society adjourned to January 16, 1879.

"*On the Formation of Baric Periodate,*" by S. SUGIURA and C. F. CROSS. In a previous paper the authors showed that by passing iodine vapour and dry air over heated oxide of barium, baric periodate was formed. This substance they find to be identical with that produced when barium iodate is heated, or when the iodide is heated in a current of dry air, in both of which cases baric periodate, $Ba_5I_2O_{12}$, is formed. This substance is therefore the most stable combination of the three elements. If barium carbonate be heated with iodine in a tube exhausted of air no combination takes place. On the admission of dry air the formation of periodate at once commences. The formation of periodate is therefore referable not to the direct replacement of oxygen by iodine and the subsequent oxidation of iodide, but to the oxidation of the iodine itself and the subsequent union of the oxidised molecule with barium oxide.

"*On Erbium and Yttrium,*" by T. S. HUMPIDGE and W. BURNEY. This paper, which is dated from Hofwyl, commences with an interesting abstract of the results obtained by various chemists who have investigated the composition of gadolinite with especial reference to the occurrence of the rare metals. The authors instituted the present series of experiments with the special object of isolating the metals, of determining their specific heats, and of discovering a better and more complete method of separation. They were unsuccessful in finding a method superior to the one proposed by Bunsen, which depends on the relative solubilities of the baric nitrates. They also failed to obtain the metals in coherent masses, black powders or small metallic scales being alone obtained. These scales slowly decomposed water at ordinary temperatures; more rapidly on warming. They burned with a brilliant white light in a Bunsen flame. By a long series of crystallisations some erbia was obtained, from which the atomic weight of 171·61 was obtained. No yttria sufficiently pure was obtained to make a similarly accurate determination of its combining weight. At the end of the paper they give two analyses of gadolinite, one from Ytterby containing P_2O_5 1·28 per cent, Yt_2O_3 35·16 per cent, Er_2O_3 4·109 per cent; the other from Hitteroë. The authors are still investigating the subject, and promise another communication.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie de des Sciences. No. 23, December 2, 1878. .

Experimental Researches on Meteoritic Ferronicks.—Stanislas Meunier.—Mixtures of iron and nickel chlorides reduced by hydrogen at a red heat yield well-defined alloys, sometimes admirably crystalline, and closely analogous to the meteoritic alloys of iron and nickel.

Novel Phenomenon of Static Electricity.—G. Govi.—The author referring to the recent paper of M. Duter declares that it would be needless to enter here into the details of his own earlier experiments, which he, however, immediately proceeds to describe.

Effects of the Vapour of Carbon Disulphide.—L. Poincaré.—From numerous and prolonged experiments upon animals the author finds that the structural lesions occasioned by the gradual action of the vapours of this compound are so serious that the use of vulcanised caoutchouc should be restrained to the preparation of articles of real utility.

Repulsion Resulting from Radiation.—W. Crookes.

On Cholalic Acid.—A. Destrem.—The author has studied the constitution of this acid, obtained by the decomposition of the biliary acids, and has examined some of its derivatives.

Biedermann's Central-blatt.
Heft 11.

Emission of Oxygen by Certain Crassulaceæ.—Prof. A. Mayer.—Leaves of various Crassulaceæ which have been kept in the dark have always an acid reaction, which, on exposure to the sun, passes into neutrality or faint alkalinity. Leaves of these plants possessing a strongly acid reaction yield more oxygen on prolonged insolation than such as have merely a slight acid reaction.

Agricultural and Chemical Experiments on Various Kinds of Tobacco.—Dr. Ricciardi, Prof. Cantoni, and E. Rotondi.—Experiments on the effect of different manures and methods of cultivation upon the yield and quality.

On Starch.—MM. Musculus and Gruber.—Taken from the *Comptes Rendus*, 1878, pp. 1459 and 1460.

Value of Different Wheats.—Prof. Werner.—The nature of this paper can be inferred from its title.

Reductive Sugar of Commerce with Reference to Polarisation.—H. Morin.—The author objects to Gunning's suggestion to apply the coefficient 0·38.

On Steeping Barley.—O. Ney and Prof. Thausing.—A polemical paper.

Optical Behaviour of Different Wines, and Recognition of Wines "Gallised" with Grape Sugar.—Prof. C. Neubauer.—The author bases his process for the recognition of such wines on the fact that they cause the plane of polarised light to deviate to the right, whilst pure natural wine is either optically inactive or occasions a deviation to the left.

The Use of Ice in the Management of Dairies.—N. J. Fjord.—The author maintains that the more strongly milk is cooled the greater is the yield of butter.

French Opinion on Start's Method of Creaming.—Prof. A. F. Pourian.—The author questions the advantages of the use of ice as above.

Detection of the Adulterations of Butter.—The process of Messrs. Angell and Hehner for the detection of extraneous fatty matters has given satisfactory results in the hands of various chemists.

Moniteur Scientifique, Quesneville.
December, 1878.

Universal Exhibition of 1878.—E. and A. Kopp contribute an interesting report on the progress of the arts of dyeing and printing.

Dyeing at the Exhibition of 1878.—Marius Moyret.—The author declares that in this department the display has been feeble, containing nothing extraordinary, and being not better but worse than that of 1867. Many of the most important firms have abstained from exhibiting at all, and others have manifested great discretion in not showing too much. They can only evince greater caution in future by abstaining altogether.

Singular Method of Stimulating the Vegetation of Seeds which Germinate with Difficulty.—Weak solutions of caustic potassa or soda are exceedingly efficacious according to Bœttger. If a handful of coffee beans are agitated for a few hours with a weak solution of potash-lye germination begins often after two or three hours.

Crystallisations of Metallic Oxides in Glass.—Dr. P. Ebell.—The combinations of silica with the alkalies, earths, &c., are at their melting-points energetic solvents for metals, oxides, and salts. Substances dissolved in igneous flux take different forms on cooling according to circumstances. If the refrigeration is rapid the solidified body is homogeneous and amorphous; if slow the dissolved substances separate either in an amorphous condition (as copper in hæmatinon), or in the state of crystals (copper in aventurin, alumina, magnetic oxide of iron, chromic oxide, &c.). Ordinary glasses are metallic oxides and salts dissolving in melting silicates and cooled in the state of solution. It is the same with transparent glasses coloured with gold, silver, and copper. Opaque glasses, such as hæmatinon, aventurin (cupric or chromic), mat glass, &c., are products of fusion, in which a precipitation takes place during the act of cooling. The theory that the metals are absorbed as such by melted glass is corroborated by the fact that at such temperatures metals like gold cannot be conceived as existing save in the reguline state.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 59, November, 1878.

Report Presented by Th. du Moncel on Edison's Electric Pen.—This paper is not capable of useful abstraction without the accompanying illustrations.

Influence of Complementary Colours in Decoration.—M. Rosenstiehl.—The author considers the following propositions as demonstrated as far as concerns the conditions of the harmony of colours. In mono-chrome decorations, derived from a single pure colour, the gradations of one and the same colour furnish among themselves harmonious arrangements, realising what M. Chevreul calls the "harmony of analogues." When a colouration is derived from two pure colours the most pleasant assortment is that of two complementaries and their derivatives. The resulting harmony is what Chevreul calls the "harmony of contrasts."

Bulletin de la Societe Chimique de Paris,
No. 11, December 5, 1878.

Action of Benzoic Acid upon Leucin.—A. Destrem.—By causing these two compounds to act upon each other in sealed tubes at 200° the author obtains leucinimid and a new substance closely analogous to the superior homologue of hippuric acid.

Combinations of Certain Metallic Salts with the Compound Ammonias.—A. Destrem.—The author, on adding phenylamin to an alcoholic solution of cupric chloride, obtains a brown crystalline precipitate,—

$$CuCl_2{}_2(O_6H_7N).$$

This is only one of a series of compounds which he is engaged in examining.

Transformation of Dibromated Ethylen into an Aceton Containing Four Atoms of Carbon by Means of Hypobromous Acid.—E. Demole.—When dibromic ethylen is submitted to oxidation there is formed a transitory compound, C_2HBr. At a lower temperature this body is polymerised, taking up HBr. At a higher temperature it takes up at once oxygen and bromic hydride, forming bromide of bromacetyl, and in presence of hypo-

bromous acid it yields a secondary hexabromic butylic alcohol.

Action of the Chlor-oxy-carbonate of Ethyl upon Certain Oxygenated Haloidic Derivatives of the Fatty Series.—O'Neill F. Kelly.—A lengthy paper, not capable of useful abstraction.

Note on the Memoirs of M. Lescœur and M. Wolff.—M. Reboul.—The author points out certain errors in the papers in question.

Gazzetta Chimica Italiana.
Anno viii., 1878. Fasc. vi. and vii.

Constitution of the Cuminic Compounds, and on Cymen.—E. Paterno.—The author argues for the existence of isopropyl in cuminic compounds.

A Regulator of the Heat of Gas-stoves Used in Chemical Laboratories.—L. Cresti.—Requires the accompanying illustrations.

On Meta-nitro-cinnamic Acid.—R. Schiff.—On treating cinnamic acid with concentrated nitric acid two nitro-cinnamic acids are produced, one of which the author examines.

On Two Mono-bromo-pyromucic Acids.—R. Schiff and G. Tassinari.—An account of the preparation and properties of the ortho- and meta-mono-bromo-pyromucic acids, both of which have the composition $C_5H_3O_3Br$.

On Benzylated Cresol.—E. Paterno and G. Mazzara.—This compound is obtained by mixing 50 grms. paracresol with a like weight of benzylic chloride and a little zinc turnings. On heating gently an energetic reaction is set up; hydrochloric acid is abundantly liberated, and a reddish brown liquid is obtained. The product of several such operations, freed from the zinc by decantation, is submitted to a first distillation at the ordinary pressure in a current of carbonic acid to separate it from unchanged chloride of benzyl and cresol. By fractionated distillation $C_{14}H_{14}O$ is obtained as a transparent liquid of a slightly yellow colour.

Certain Derivatives of Arachic Acid.—G. Tassinari.—The derivatives in question are the arachic-acetic and arachic-valeric acids, both anhydrous, the chloride of arachyl, nitro-arachic and amido-arachic acids.

Certain Derivatives of Santonin.—S. Cannizzaro and L. Valente.—These derivatives are hydrosantonic acid, metasantonic chloride, methylic metasantonate, parasantonide, parasantonic acid, methylic and ethylic parasantonates, and hydrosantonide.

On Two Other Isomers of Santonin.—S. Cannizzaro and Carnelutti.—These compounds are metasantonin, melting at 160·5°, and an isomer which melts at 136°.

Crystalline Form of Certain Derivatives of Santonin.—Giovanni Struver.—Not suitable for abstraction.

Crystallographic and Chemical Notes on Benzylic Santonate and on Tribenzylamin and its Principal Salts.—Dr. R. Panebianco.—This paper, consisting essentially of tables of angles as measured and calculated, is incapable of useful abstraction.

NOTES AND QUERIES.

Sugar Manufacturing.—Will any of your readers inform me which is the best book on sugar and its manufacture from the cane? and also which is the best book on practical chemistry?—VIC. S.

Oils.—Can any of your correspondents inform me of any good treatise on the different kind of oils, and the best way of testing the quality? Any information will be gladly received.—R. J.

Coal-Tar Distillation.—(Reply to R. J.)—I think R. J. will find what he requires in a manualette published by Van Voorst at half-a-crown, entitled "Destructive Distillation," by E. J. Mills. Though a small book, it treats briefly on the whole of the industries interested in destructive distillation, and also gives a few pages of bibliography of the subject. I think it has only been published about twelve months.—W. B. J.

TO CORRESPONDENTS.

ERRATUM.—In the report of the Chemical Society, p. 283, col. 2, line 30 from top, *for* G. W. Slatter *read* G. W. Hatler.

J. F. Armstrong.—Will this correspondent kindly give the information for the benefit of the readers of the readers of the CHEMICAL NEWS.

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